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THE DEMAND FOR ENGINEERS

1981

conducted by the
ENGINEERING MANPOWER COMMISSION
of the
AMERICAN ASSOCIATION OF
ENGINEERING SOCIETIES, INC.

THE
DEMAND FOR ENGINEERS
1981

ENGINEERING MANPOWER COMMISSION

A Commission of the Engineering Affairs Council
of the
American Association of Engineering Societies, Inc.

345 East 47th Street
New York, New York 10017

AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES, INC.

The American Association of Engineering Societies (AAES) is a national federation of 43 organizations representing nearly one million engineers.

As a central coordinating organization, AAES focuses the resources of the engineering societies on technological issues of national and international importance.

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The Engineering Manpower Commission was organized in 1950 to serve as a focus for national technological manpower issues.

The Commission's program is carried out through the collection, analysis, and publication of significant data on engineering manpower, as well as the development of programs and policies designed to acquaint the public with the importance of engineering to the national welfare.

The Engineering Manpower Commission is charged with the following responsibility:

> *"To engage in studies and analyses of the supply, demand, and utilization of engineering and technical manpower; to make recommendations, conduct programs and develop reports concerning these aspects of engineering and technical manpower; and to carry on such other programs in the field of manpower as may be authorized by the Engineering Affairs Council of AAES."*

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TABLE OF CONTENTS

Acknowledgements 1
Introduction 3
Summary, 1981 Survey of Engineering Demand 5
Summary of Composite Results 7
Index of Appendices 25

Index of Tables

Table 1A. Individual Engineer Employment Status 9
1B. Contents in Employment Status Reports 10
1C. Employment by Years Since Bachelor's Degree 10
1D. Employment Status by Size of Engineering Work Force 11

Table 2A. Employment Trend Viewpoint, Individual Engineer 12
2B. Employment Trend Viewpoint 13
2C. Employment Trend Viewpoint by Region 14

Table 3. Employers' Estimates of Change 15

Table 4A-1. Employment Trends by Branch of Engineering 16
4A-2. Net Hires by Branch of Engineering 17
4B-1. Regional Employment Trends 18
4B-2. Regional Net Hires 18

Table 5. Highest Degree Earned 19

Table 6. Geographical Distribution of Respondents 20

Table 7A. Size of *Engineering* Work Force 21
7B. Size of *Total* Work Force 21

Table 8A. Activity of Employing Organization 22
8B. Contrast in Job-Seeking by Employment Organization 23

Table 9. Distribution Among Branches of Engineering 23

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The Engineering Manpower Commission is indebted to two groups for furnishing the data on which this report is based. The first group consists of working engineers who responded as members of a random sample of their membership selected by each of the AAES engineering societies listed in Appendix C1. The second group, listed in Appendix C2, is made up of employers of engineers. The support of these two groups and the participating societies is gratefully acknowledged.

We are also much indebted to the continuing efforts of the EMC Demand Survey Committee, co-chaired by Arthur F. Dershowitz (AACE) and Eugene T. Daniel. This committee provided the essential plan for the survey, designed the questionnaires, and offered guidance on the make-up of this report. Special thanks are owed to Commissioners August Mundel (ASQC), Donald Schroeter (AIChE), Lawrence Whippel (ASCE), Robert Barden (IEEE), Stanley M. Brodsky, and Louis Marturana for actively contributing to the committee their time and professional expertise.

We also appreciate discerning comments from Kenneth Humphreys, Executive Secretary of AACE, who read the draft of this text and who has conducted a demand survey of AACE membership in parallel with, and as part of, this study.

The conduct of the survey, data analysis, and preparation of the final report were carried out by Arthur W. Gilmore, a consultant to EMC, and Arthur F. Dershowitz. Gerard Knight developed the computer programs used to analyze the demand data.

INTRODUCTION

Background

Intermittently, since its formation during the Korean War, the Engineering Manpower Commission has surveyed employers of engineers to obtain information regarding the current demand for engineers. A few years ago, this survey was discontinued because of criticism that this information was being used to "predict" demand several years ahead, despite its clearly stated unreliability for this purpose. Since then, there have been numerous requests for information relating to the demand for engineers. Therefore, the Commission agreed to gather and present demand data for **short-term** planning purposes.

In order to ensure proper consideration of the many problems involved in setting objectives, designing the survey formats, selecting target populations, establishing timetables, and defining reporting criteria, a Demand Survey Sub-Committee of EMC was appointed.

The committee recommended in 1980 that a survey of individual engineers should be conducted with a simultaneous survey of engineering employers. That survey, "A Pilot Study of the Demand for Engineers," was executed, reporting the demand as of May 1, 1980. The resultant report, *A Pilot Study of the Demand for Engineers,* was published by EMC in April of 1981.

Because of the interest generated by this "pilot study," EMC decided to reinitiate the study in 1981, changing the reporting date to October 31 instead of May 1. This change was made to have the demand survey coincide more closely with critical periods in employers' planning of the recruitment of engineering manpower. A few changes were made in Survey Form A, which was sent to individual society members. The changes were directed at simplifying certain portions, making the engineer sample more consistent with the employer sample, and extending the data to include an indication of the total work force, as well as engineering work force in the employing organization. Appendix A contains copies of survey instruments for both the individual engineer and employer samples.

The populations of both the individual engineer sample and the employer sample addressed by the 1981 survey were expanded considerably from those in the "pilot" survey, and were designed to be representative of the membership of constituent Societies of AAES. However, the committee wished to note the following:

1. The information requested of both samples limits the demand prediction to one year from the baseline conditions reported as of October 31, 1981.
2. The reported results can be considered only **indicative** of, and should *not* be interpreted as an **absolute measure of,** current demand trends.
3. The validity of such a survey can be estimated only by comparing predictions and results from successive surveys executed over a period of years.

Sample Selection, Mailings and Returns

Individual Engineers:

A randomly selected sample of 11,610 primarily U.S. members of 23 technical societies were addressed using the letter and survey forms shown in Appendix A. From this single mailing, 3,081 useable returns were obtained, showing a valid response of 26.5%. On receiving a valid return with a clear indication of primary technical society affiliation, the return was filed under that society heading. Of those societies surveyed, only the following, in rank order of number of useable returns, proved to have a sufficient number to be meaningful:

American Society of Mechanical Engineers	(ASME)
Institute of Electrical and Electronic Engineers	(IEEE)
American Society of Civil Engineers	(ASCE)
American Institute of Chemical Engineers	(AIChE)
National Society of Professional Engineers	(NSPE)
American Institute of Industrial Engineers	(AIIE)
National Institute of Ceramic Engineers	(NICE)
American Institute of Plant Engineers	(AIPE)
American Society of Agricultural Engineers	(ASAE)
American Nuclear Society	(ANS)

Results are presented in Appendix B1 in abbreviated form for the composite total of all individual returns, and for each of the above listed societies. Information on others in the list of 23 participating societies is shown in Appendix C1. Although salary data are reported in composites, in Appendix B1, analyses are difficult due to variations in the populations reporting history and forecasts.

Selections of random samples from listings of individual engineers furnished by the engineering societies was developed with the intent of achieving a reasonable balance between the largest society, having approximately 131,000 members, and the smallest society, having about 600 members. In order to avoid weighting the selection in favor of the larger societies and yet yield a projected sample of approximately 12,000, it was decided to calculate the sample size from a given society by the relation, $4\sqrt{n}$, in which "n" is the total society membership. Details of society response are shown in Appendix C1-B.

Employers:

A total of 2,787 employers of engineers were selected for both an initial and a follow-up mailing, assuming an anticipated return of about 30%. As of the date of this report, 273 useable returns have been received, 14% of which are government agencies, 11% are consulting engineering firms, and the balance, approximately 75%, are business firms. In aggregate, this sample of organizations employs 100,439 engineers.

Summaries of the employers engineering work force history and forecasts by discipline and region are tabulated in Appendix B2.

Projections of Long-Term Trends Not Feasible

The data contained in this booklet should not be used for extrapolating long-term trends. Long-term trends are dependent on many factors not addressed by respondents to this survey. Among such factors are:

1. The amount and distribution of federal expenditures for energy, defense, EPA, and highway projects, including synfuel and space, especially their R & D components, which are engineering labor intensive.
2. Industrial expenditures on R & D and capital investment, which are impacted by tax treatment, regulation burden, cost of money, investment philosophy, and willingness to venture, compete, or export.
3. The secular trend of the economy, which determines the level of output of industries which employ engineers.
4. Scientific breakthroughs, such as microprocessors, which have a disproportionate effect on engineering requirements for development.
5. The transfer of engineers to other occupations, which creates new engineering job openings.

We welcome your comments, recommendations, and advice as to whether this is the proper approach, or whether we should continue this research.

SUMMARY
1981 SURVEY OF ENGINEERING DEMAND

The Engineering Manpower Commission, organized under the Engineering Affairs Council of the American Association of Engineering Societies, has completed a survey of engineering employers and of individual engineers to record their views of near-term (1982) demand for engineers.

This survey is a successor to the Commission's 1980, "Pilot Study of Demand for Engineers—1981," and builds on some of the experience from that study.

This survey attempts to provide the following unique contributions to the study of short-term demand:

1. An exchange of insights on demand between individual engineers and employers.
2. A comparison of the proportion of engineers seeking employment with employers' plans for hiring experienced engineers. Included is a profile of engineers seeking jobs.
3. Identification of some factors associated with individual engineers' optimism (or pessimism) concerning demand, e.g., professional discipline, age, geographic location, and industry.

Definition of the term "demand" and the difficulty of precisely describing "engineer" were problems that confronted the survey committee. A survey questionnaire was designed to minimize the ambiguity of these and other terms. Suggestions made by the respondents should improve the questionnaire for future surveys. There remains sufficient ambiguity, however, so that data are summarized, sorted, and reported as they were received, and only limited conclusions are presented.

The EMC demand study contains summaries of demand by five engineering categories and ten geographic regions. Practicing engineers reported their views on growth in their profession and their industry. Employers reported history and demand by five engineering categories, as well as for "other" engineers. Comparisons of views of engineering demand by category have been made, however, some definitional problems should be recognized. For example, engineers reported by professional society affiliation, while employers reported on the basis of engineering job assignment.

Although employer and employee survey samples were similar in many respects, significant differences did exist. The main differences in the composition of the two samples were:

1. **Employer Size:** There is a greater representation of engineers working for small employers in the employee sample than in the employer sample.
2. **Society or Discipline:** There is a greater overall representation of engineers from smaller societies in the sample of individuals and a greater representation of electrical engineers in the employer sample.
3. **Industry and Education Level:** There is an inadequate sample of educators in the employer sample and, correspondingly, a greater representation of Ph.D.'s in the individual engineers' sample.

Overall Findings

While both employer and individual engineer survey populations reported a guardedly optimistic view, both felt that demand expectations in the coming year will be below those reported for 1981. Generally, the employers predicted an overall increase of nearly seven percent in the engineering work force. Because of the economic turmoil experienced in the winter of 1981-1982, a follow-up telephone survey was conducted in April, 1982. It indicated that a six percent increase was more likely, and that the bulk of the hiring for the period had taken place before April.

It should be noted that employers surveyed expect that, as in 1981, net increases will come principally from hiring new graduates, rather than experienced engineers. While employers expected about a 10% turnover among experienced engineers, about 15% of experienced engineers surveyed were seeking new engineering employment.

Categorical Findings

- Data from individual chemical engineers and industrial engineers indicate more optimism than data from employers.
- Data from individual civil engineers reflect significantly more pessimism than data from employers.
- Data from individual engineers in Pacific and Mountain states are more optimistic than data from employers in those regions.
- Data from individual engineers in Mid-atlantic states are more pessimistic than data from Mid-atlantic employers.
- Engineers seeking new engineering employment at more than average rates include federal government employees and those working in the electronic equipment and computer industries. Thus, seeking employment does not correlate with prospects for growth in demand.

Differences among disciplines and experience have a greater effect on individual perceptions of demand than does employer size. Engineers seeking employment include both those most optimistic and those least optimistic about rising demand.

Analyses of Returns

Information Requested

Questionnaires sent to both individual engineers and employers were designed to provide two types of information:

1. An assessment of the present and future engineering demand; and
2. A profile of engineers represented in the survey.

Thus, the individual engineers' questionnaire requested profile data such as highest degree attained, employment group, geographic location, and size of employer's engineering work force. In addition, demand data such as current employment status, expectations of future employment, past, present, and future salary level, and opinions of trends in engineering employment were requested.

Both groups provided demand-related information as of October 31, 1981.

Data Reduction

In order to handle the processing of the large amount of data contained in the returns, a computer program using the Pascal language was developed for use on the Univac-1100 computer at SUNY-Stony Brook.

Format of the Final Report

Current and forecast demand status are summarized by each of the two survey groups.

The individual engineer summary includes comparisons of actual and forecast employment status and demand by years since graduation, by size of work force, by society affiliation, and by geographic region.

Employer trends then are reported and comparisons of individual engineer and employer expectations are tabulated.

Information in the appendices includes:

1. Medians for individual societies;
2. Summaries of employer data; and
3. Technical comparisons
   - with 1980 pilot study of the demand for engineers
   - with other studies
   - internally, examining the statistical range of data subsets.

SUMMARY OF COMPOSITE RESULTS

SUMMARY OF COMPOSITE RESULTS

This section summarizes trends in demand from both individual engineer and employer viewpoints, compares the composition of the samples from which the individual engineer and employer composites were drawn, and comments briefly on the samples and trends.

More detailed summaries of the processed data may be found in Appendix B.

A. Trends in Demand

Individual Engineer Viewpoint:

Generally, engineers expect a slight decrease in employment and possibly some acceleration of retirements, as illustrated in Table 1A. However, differences are obscured by the "no answer" response to requests for forecasting 1982 status.

The last column of Table 1A shows a comparison of the distribution of the status reported by 3,081 individual engineers in 1982 and their status in 1981. That last column shows only a small decrease (1.8 points) in the proportion of engineers employed in engineering or engineering-related work. This 1.8 point decrease is compensated for by changes in the proportion not answering (0.8 points), retired (0.7 points), or other (0.3 points).

Table 1B details the "Points Change 82-81" column for tables similar to Table 1A. The first column repeats data from Table 1A. The second column reports the points change 82-81 for the subset of 1,507 individual engineers who forecast rises in demand in their profession. The third column similarly reports for the subset of 356 individuals who forecast declines in their profession; the succeeding columns report on subsets concerning regional forecasts and engineers seeking new engineering employment.

TABLE 1A

INDIVIDUAL ENGINEER EMPLOYMENT STATUS

	1980 Status % Replies		1981 Status % Replies		Points Change 81–80		1982 Expected Status % Replies		Points Change 82–81	
Employed as Engineer	75.3		74.0		(1.3)		72.6		(1.4)	
Employed Engr.-Related Work	11.5		11.5		0.0		11.1		(0.4)	
Sub-Total		**86.8**		**85.5**		**(1.3)**		**83.7**		**(1.8)**
Employed Non-Engineer Work		5.1		5.3		0.2		5.2		(0.1)
Part-time Engr. Work	1.3		1.1		(0.2)		1.3		0.2	
Part-time Engr.-Related Work	0.6		0.7		0.1		0.6		(0.1)	
Part-time Non-Engr. Work	0.2		0.3		0.1		0.3		0.0	
Sub-Total		**2.0**		**2.0**		**0.0**		**2.1**		**0.1**
Unemployed, Not Retired		0.5		0.4		(0.1)		0.3		(0.1)
Retired		3.0		3.3		0.3		4.0		0.7
Other		1.4		0.9		(0.5)		1.2		0.3
No Answer		1.2		2.6		1.4		3.4		0.8
Total Rounded		100.0		100.0		0.0		100.0		0.0

( ) denotes negative value

Among "optimists," i.e., those forecasting rises in demand, decrease in employment is largely balanced by retirement. On the other hand, among "pessimists," i.e., those forecasting declining demand, decrease in the proportion expecting to be employed is balanced by unemployment and part-time employment but also, significantly, by the "no answer" or "other groups." This may indicate some bias toward non-response among engineers who are pessimistic.

In the subset of 395 individuals who are seeking employment, there is an expectation of decrease in unemployment, part-time employment, and non-engineering employment, offset by "no answer" or "other," rather than by increased expectation of employment.

A comparison of employment status by years since bachelor's degree is shown in Table 1C. The proportion of engineers who are retired increases with age, as might be expected. However, there is also a notable trend towards part-time employment as age increases. The expectation of unemployment, however, is quite stable, except among the oldest group.

TABLE 1B

CONTRASTS IN EMPLOYMENT STATUS REPORTS
(Points of Percentage Change 82/81)

		Profession		*Local Area*			
	Overall	**Forecast Rise**	**Forecast Decline**	**Forecast Rise**	**Forecast Decline**	**Seeking**	**Not Seeking**
Employed as Engineer Sub-Total	(1.8)	(0.5)	(3.9)	(0.9)	(3.6)	(0.5)	(1.8)
Employed Non-Engineer Work	(0.1)	(0.3)	(0.3)	(0.3)	(0.3)	(0.8)	(0.2)
Part-time Employed Sub-Total	0.1	(0.5)	0.3	(0.4)	0.7	(1.0)	0.2
Unemployed, Not Retired	(0.1)	(0.1)	1.1	(0.3)	0.5	(0.8)	0.0
Retired	0.7	0.9	0.3	1.0	0.3	0.3	0.9
Other	0.3	0.1	0.8	0.3	0.8	0.8	0.2
No Answer	0.8	0.3	1.7	0.6	1.6	2.0	0.7
Total Rounded	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Replies	3081	1507	356	1140	607	395	2519

( ) denotes negative value

TABLE 1C

EMPLOYMENT STATUS BY YEARS SINCE BACHELOR'S DEGREE

	Overall		**0-10**		**10-20**		**20-30**		**30-40**		**40-50**	
	81	**82**	**81**	**82**	**81**	**82**	**81**	**82**	**81**	**82**	**81**	**82**
	%		%		%		%		%		%	
Employed as Engineer Sub-total	85.5	83.7	89.0	88.2	89.8	88.7	90.7	89.1	84.9	83.5	42.0	32.0
Employed Non-Engineer Work	5.3	5.2	4.1	3.3	6.2	6.6	5.6	5.8	6.4	6.0	5.3	4.7
Part-time Employed Sub-total	2.0	2.1	1.7	1.8	1.0	1.0	0.9	0.9	2.3	1.9	13.3	14.7
Unemployed, Not Retired	0.4	0.3	0.5	0.5	0.4	0.3	0.3	0.3	0.4	0.0	1.3	2.0
Retired	3.3	4.0	0.2	0.2	0.1	0.4	0.3	0.4	2.7	4.5	32.7	40.0
Other	0.9	1.2	1.0	1.8	0.5	0.5	0.1	0.3	1.2	1.4	3.3	4.0
No Answer	2.6	3.4	3.5	4.2	1.9	2.5	2.1	3.2	2.1	2.7	2.0	2.7
Total Rounded	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Replies	3081		790		726		676		515		150	

When the employment status of the individual engineer is analyzed by the size of the engineering work force, as shown in Table 1D, differences are not statistically significant, although it might appear that prospects are slightly poorer for engineers in small work forces.

Considerable turnover is expected (about 15% of engineers are seeking employment). The statistics of those seeking employment are explored in greater detail under "Make-up of Sample" below, since these data relate to supply, rather than demand.

TABLE 1D

EMPLOYMENT STATUS BY SIZE OF ENGINEERING WORK FORCE

	Overall			*Small Self-employed or fewer than 100 Engineers*			*Large Employer with more than 100 Engineers*		
	81	82	Points Change	81	82	Points Change	81	82	Points Change
	%			%			%		
Employed as Engineer Sub-total	85.5	83.7	(1.8)	86.2	84.0	(2.2)	90.3	88.6	(1.7)
Employed Non-Engineer Work	5.3	5.2	(0.1)	6.1	5.9	(0.2)	4.1	4.1	0.0
Part-time Employed Sub-total	2.0	2.1	0.1	2.7	2.9	0.2	0.8	0.9	0.1
Unemployed, Not Retired	0.4	0.3	(0.1)	0.3	0.5	0.2	0.3	0.2	(0.1)
Retired	3.3	4.0	0.7	1.7	2.3	0.6	1.5	2.5	1.0
Other	0.9	1.2	0.3	0.7	1.0	0.3	0.4	0.7	0.3
No Answer	2.6	3.4	0.8	2.4	3.6	1.1	2.6	3.1	0.5
Total Rounded	100.0	100.0	0.0	100.0	100.0	0.0	100.0	100.0	0.0
Number of Replies		3081			1173			1211	

( ) denotes negative value

A plurality of engineers are optimistic about employment in their own disciplines, but are more cautious about employment in their own geographic areas and within their employer's organization, as shown in Table 2A. A comparison of the society distribution of those who see rises and declines in their profession is shown in Table 2B. A similar analysis of the regional distribution of those who see rises and declines in their region is shown in Table 2C.

In general, Table 2A indicates that optimism declines with experience or age. However, in all cases, less than 25% of the engineers replying foresee a decline in the demand for engineers.

TABLE 2A

EMPLOYMENT TREND VIEWPOINT INDIVIDUAL ENGINEER

	Years Since B.S.	% Rise	% Remain Steady	% Decline	% No Answers
In Professional Discipline	**Overall**	48.9	34.2	11.6	5.3
	0-10	56.4	32.2	8.1	3.3
	10-20	48.6	36.2	11.4	3.7
	20-30	49.6	33.1	13.0	4.3
	30-40	41.9	37.9	14.6	5.6
	40-50	39.3	32.0	14.0	14.7
In Local Area	**Overall**	37.0	37.5	19.7	5.8
	0-10	40.6	39.3	16.7	3.4
	10-20	37.7	38.6	19.8	3.9
	20-30	37.3	36.2	21.3	5.2
	30-40	33.0	38.5	21.7	6.8
	40-50	31.3	34.7	19.3	14.7
In Employer Organization	**Overall**	34.6	40.3	17.7	7.4
	0-10	38.1	41.5	15.8	4.6
	10-20	36.0	40.5	19.0	4.5
	20-30	33.0	41.3	18.9	6.8
	30-40	32.1	41.0	18.5	8.4
	40-50	27.0	30.3	18.3	24.4

Table 2B compares the overall distribution of engineers individual survey respondents across professional societies with the separate distributions of the subset of 1,507 engineers forecasting a rise in demand for their profession, and the subset of 356 forecasting a decline. This comparison indicates "optimists" are more likely to be found among electrical engineers (IEEE), chemical engineers (AIChE), industrial engineers (AIIE), and plastics engineers (SPE). Declines in expectation are more likely among civil engineers (ASCE), and agricultural engineers (ASAE). There is a slight indication that mechanical engineers (ASME) are more likely than average to expect either a rise or decline than to expect stability. Within the larger societies specific proportions expecting rises and declines are shown in Table 4A-1. Further identification of optimists and pessimists may be found in Appendix D3-2A.

Table 2C compares the overall regional distribution of engineers, with the regional distribution of the subset of 1,140 engineers who forecast rising demand in their local area and the regional distribution of the subset of 607 individuals who forecast a decline.

TABLE 2B

EMPLOYMENT TREND VIEWPOINT BY PROFESSIONAL SOCIETY

	% Overall Distribution	% Distribution Among Engineers Seeing Rise In Profession	% Distribution Among Engineers Seeing Decline In Profession
ASME	15.0	15.4	16.0
IEEE	13.2	14.9	9.3
ASCE	13.1	9.6	18.3
AIChE	8.9	9.8	7.3
NSPE	7.9	7.5	11.0
AIIE	4.5	6.1	1.4
NICE	4.4	4.3	3.6
AIPE	4.1	3.9	2.5
ASAE	3.6	2.3	5.9
ANS	2.8	3.1	3.9
ASHRAE	2.8	2.3	3.4
ASM	2.5	2.5	2.5
SPE	2.5	3.1	1.4
SME	2.3	2.2	2.8
ASQC	2.0	2.1	2.5
ASEE	1.6	1.7	1.1
AACE	1.2	1.3	1.4
SFPE	1.2	1.4	0.6
SSS	0.8	0.9	0.8
SWE	0.8	0.8	0.8
AIME	0.7	0.9	0.6
SES	0.3	0.1	0.0
AAEE	0.2	0.1	0.3
AEE	0.1	0.1	0.3
NCEE	0.1	0.1	0.0
Other Societies	0.3	0.3	0.3
No Society	3.1	3.1	1.7
Total Rounded	100.0	100.0	100.0
Number of Replies	3081	1507	356

Expectations of demand, as are shown in Table 2C, are quite localized. The West South Central states, as well as the Mountain and Pacific states, have a disproportionately high number of engineers expecting a rise in demand. Conversely, the East North Central and West North Central states are disproportionate sources of expected declines. The Middle Atlantic, while not strongly forecasting a decline, is less inclined than average to forecast a rise. Specific proportions within a region expecting rises or declines are shown in Table 4B-1.

TABLE 2C

EMPLOYMENT TREND VIEWPOINT BY REGION

	% Overall Distribution	% Distribution Among Engineers Seeing Rise In Local Area	% Distribution Among Engineers Seeing Decline In Local Area
Middle Atlantic	17.7	15.1	18.1
East North Central	17.6	11.3	24.7
Pacific	15.0	18.2	11.2
South Atlantic	13.8	14.4	14.0
West South Central	8.4	14.4	3.3
New England	7.9	8.2	6.8
West North Central	6.1	4.1	9.2
Mountain	5.4	7.2	4.4
East South Central	4.2	4.5	4.1
U.S. General/ Multi-regional	0.8	0.5	0.7
Puerto Rico	0.4	0.4	0.8
Non-U.S.	1.0	1.0	0.8
No Answer on Region	1.7	0.9	1.8
Total Rounded	100.0	100.0	100.0
Number of Replies	3081	1140	607

Employer Viewpoint

On the whole, employers predict growth in the employment of engineers. The projected 1982 growth rate of 6.9% is 80% below the 8.6% growth rate experienced in 1981, as shown in Table 3.

Because of current economic uncertainties, a sample of the responding employers was re-surveyed by telephone in April of 1982. In most cases, only small net decreases in growth (equivalent in total to 7.7% of the estimate) were reported. Assuming the sample subset was typical (it was distributed by region and industry), such a reduction would reduce growth from the 6.9% shown in Table 3 to 6.4%. This would further reduce the demand for engineers to 74% of the 1981 growth rate.

Significantly, however, a number of employers had indicated that they had already achieved their 1982 growth targets and that they would not be making additional offers. This might affect the placement of engineering graduates, on which EMC will report later in 1982.*

**Placement of Engineering and Technology Graduates, 1982*, a report of an annual survey conducted by The Engineering Manpower Commission.

TABLE 3

EMPLOYERS OF ENGINEERS—ESTIMATES OF CHANGE IN ENGINEERING EMPLOYMENT

Engineers Employed As of 10/31/81	Number of Employers Reporting	Openings Reported As of 10/31/81		Growth 10/31/80-10/31/81		Estimated Growth 10/31/81-10/31/82	
		Number	%	Number	%	Number	%
100,439	273	9,330	9.3	7,999	8.6	6,930	6.9

Comparison of Trend Expectations

Tables 4A-1 and 4A-2 compare expectations of individuals and employers by branch of engineering.

By and large, employers expect the overall growth from 1981 to 1982, as from 1980 to 1981, to be made up of college hires, while experienced engineers hired will nearly balance separations. The exception to this lies in the poorly-defined "all others" group, which includes a high proportion (28%) of engineers reported without degrees, the results from a few companies where no estimates of discipline breakdown were reported, and the group which includes other recognized disciplines.

Data from engineers, especially chemical and industrial engineers, seem to be more optimistic than data from employers. Civil engineers are the most pessimistic, and a larger percentage of them forecast a decline.

TABLE 4A-1

EMPLOYMENT TRENDS BY BRANCH OF ENGINEERING

	Individual Engineers Trend Viewpoint			Employers Net Experienced Hires			
	Rise	Decline	Seeking	1982/1981R		1981R/1980R	
	%	%	%	No.	%	No.	%
Chemical (AIChE)	54.2	9.5	11.1	(136)	(1.5)	78	0.9
Civil (ASCE)	35.9	16.1	13.6	(4)	0.0	(9)	0.0
Electrical (IEEE)	55.2	8.1	14.0	143	0.5	229	(0.9)
Industrial (AIIE)	66.7	3.6	19.6	(21)	(1.0)	72	(3.5)
Mechanical (ASME)	50.3	12.4	17.4	301	1.8	251	1.6
Overall	48.9	11.6	14.8	1722	1.7	2526	2.7

NOTES: 82E—Estimated for 10/31/81 to 10/31/82
81R—Reported actual for 10/31/80 to 10/31/81
80R—Reported actual for 10/31/79 to 10/31/80
( )—Denotes negative Value

Engineers tend to be optimistic about growth in their regions, as noted in Tables 4B-1 and 4B-2. Individual engineers in West South Central states are more strongly optimistic about regional growth in engineering employment; those in New England, East South Central, and South Atlantic states are moderately optimistic; and those in the West North Central and East North Central states are relatively pessimistic. This is consistent with prospects forecast by employers.

On the other hand, in the Pacific and Mountain states, individual engineers are relatively more optimistic than the employers surveyed. Conversely, engineers in Mid-Atlantic states are relatively more pessimistic than the employers.

By reference to the numerical data shown in Appendix B2-A, it may be noted that employers expect to bring 10,120 experienced engineers into their engineering work force of 100,439. This will result in a 10.1% increase in their engineering work force.

However, according to the survey of individual engineers, 14 to 15% of the work force is looking for other employment. This includes 0.4% of the survey population who are unemployed and some of the 2.0% who are employed part-time.

Overall, the responses from both survey groups indicate that demand for engineers is expected to continue during 1982 at a level below that existing throughout 1981. Individual engineers, as noted in Appendix D, are, for example, less optimistic about rising demand than in 1981. The percentage of overall net hires estimated by the employer sample for 1982 is slightly less than 7 percent of the current engineering work force.

TABLE 4A-2

NET HIRES BY BRANCH OF ENGINEERING

(% of Engineers Employed)

	Experienced		College		Net Total	
	82E/81R	81R/80R	82E/81R	81R/80R	82E/81R	81R/80R
Chemical (AIChE)	(1.5)	0.9	3.7	4.5	2.2	5.4
Civil (ASCE)	0.0	0.0	4.2	5.7	4.2	5.7
Electrical (IEEE)	0.5	(0.9)	6.5	7.3	7.0	6.4
Industrial (AIIE)	(1.0)	(3.5)	7.7	6.2	6.7	2.7
Mechanical (ASME)	1.8	(1.6)	5.6	10.0	7.4	8.4
Overall	1.7	2.7	5.2	5.9	6.9	8.6

NOTES: 82E—Estimated for 10 31 81 to 10 31 82
81R—Reported actual for 10 31 80 to 10 31 81
80R—Reported actual for 10 31 79 to 10 31 80
( )—Denotes negative Value

TABLE 4B-1

REGIONAL EMPLOYMENT TRENDS

	Individual Engineers Trend Viewpoint				Employers Net Experienced Hires			
					1982/1981R		1981R/1980R	
	Count	% Rise	% Decline	% Seeking	No.	%	No.	%
U.S. Gen./Multi-regional	24	25.0	16.7	29.2	1819	4.8	3208	10.1
Pacific	461	44.7	14.8	14.1	(586)	(2.0)	(358)	(1.3)
East N. Central	543	23.8	27.6	14.4	(26)	(0.3)	(144)	(1.9)
Mid-Atlantic	545	31.6	20.2	15.4	353	5.1	(36)	(0.5)
West S. Central	258	63.6	7.8	15.5	50	1.2	(66)	(1.7)
South Atlantic	426	38.5	20.0	14.6	163	4.1	(77)	(2.0)
Mountain	166	49.4	16.3	14.5	(11)	(0.3)	96	3.0
West N. Central	189	24.9	29.6	12.7	(112)	(3.9)	(127)	(4.5)
New England	244	38.1	16.8	16.4	20	0.9	(82)	(3.8)
East S. Central	130	39.2	19.2	14.6	52	2.6	112	6.3
Overall	3081	37.0	19.7	15.0	1722	1.7	2526	2.7

NOTES: 82E—Estimated for 10/31/81 to 10/31/82
81R—Reported actual for 10/31/80 to 10/31/81
80R—Reported actual for 10/31/79 to 10/31/80
( ) Denotes negative value

TABLE 4B-2

REGIONAL NET HIRES

(% of Engineers Employed)

	Experienced		College		Net Total	
	82E/81R	81R/80R	82E/81R	81R/80R	82E/81R	81R/80R
U.S. Gen./Multi-regional	4.8	10.1	6.3	8.7	11.1	18.8
Pacific	(2.0)	(1.3)	4.0	4.3	2.0	3.0
East N. Central	(0.3)	(1.9)	4.5	4.8	4.2	2.9
Mid-Atlantic	5.1	(0.5)	5.0	1.9	10.1	1.4
West S. Central	1.2	(1.7)	7.9	9.3	9.1	7.6
South Atlantic	4.1	(2.0)	6.0	3.8	10.1	1.8
Mountain	(0.3)	3.0	2.7	5.5	2.4	8.5
West N. Central	(3.9)	(4.5)	4.1	5.0	0.2	0.5
New England	(0.9)	(3.8)	3.4	2.1	2.5	(1.7)
East S. Central	2.6	6.3	6.7	7.3	9.3	13.6
Overall	1.7	2.7	5.2	5.9	6.9	8.6

NOTES: 82E—Estimated for 10/31/81 to 10/31/82
81R—Reported actual for 10/31/80 to 10/31/81
80R—Reported actual for 10/31/79 to 10/31/80
( ) Denotes negative value

Make-up of the Samples

Highest Degree

Table 5 illustrates the distribution of engineers in terms of highest degree reported by the individual engineer (overall), the individual engineer subset of those seeking new engineering employment, and by employers of engineers.

Over half of the respondents to the question reported bachelor's as the highest degree. Individual engineers sampled were, on the average, more highly educated than those in the employer reports because of small sampling of educational institutions among employers. Job seekers appeared particularly concentrated at the master's and engineer professional levels. Forty-seven percent of the individual respondents indicated they were registered professional engineers. If respondents who reported NSPE affiliation are excluded from the count, this proportion drops to 43 percent, somewhat higher than the 41 percent implied by the 1981 report of the National Council of Engineering Examiners, which includes duplicate registration. However, only 38% of the engineers seeking employment were registered.

TABLE 5

HIGHEST DEGREE EARNED

As Reported By:

	Societal Members Form A (% of replies)			Seeking Engineering Employment		Engineering Employers Form B (% engineers employed)	
	All Returns						
B.S.	45			44		57	
M.S.	22	} 27		25	} 31	21	} 21
ENGR.	5			6		—	
PH.D.	12			10		6	
ASSOC.	2	} 2.3		2	} 2.5	—	} 16
NO DEGREE	0.3			0.5		16	
NO ANSWER	13.7			12.5		—	
TOTAL	100.0			100.0		100.0	

Work Location

Table 6 shows the geographic distribution of the individual engineer respondents, the employment-seeking engineers, and the responding employers.

A slightly smaller proportion of the subset of engineers seeking jobs were in the East North Central states than in the overall sample, with the correspondingly higher proportion of seekers split between West South Central and New England States.

While the geographic distribution of employer respondents roughly paralleled that of the individual engineers, the distribution of the number of employees represented by responding employers was distorted by large employers in the Pacific region and by a few large employers who would only respond on a multi-regional basis.

TABLE 6

GEOGRAPHICAL DISTRIBUTION OF RESPONDENTS

	Individual Engineers		Engineering Employer	
	FORM A % (OVERALL)	FORM A % (SEEKING ENGINEERING EMPLOYMENT)	% NO. EMPLOYERS	FORM B COMPOSITE (% OF ENGINEERS EMPLOYED)
Mid-Atlantic	18	18	14	7
East North Central	18	16	25	8
Pacific	15	14	12	29
South Atlantic	14	14	13	4
West South Central	8	9	7	4
New England	8	9	7	2
West North Central	6	6	11	3
Mountain	5	5	5	3
East South Central	4	4	3	2
Multi-Regional	1	2	3	38
Other & No Answer	3	3	—	—
Number of Replies	3081	395	273	100,439

Size of Work Force

Most engineers responding were from organizations having 100 or fewer engineers. Most of the 273 employers sampled also had fewer than 100 engineering employees. However, as shown in Table 7A, the largest number of employers were in the 10-99 engineering employee range, but represented only 5% of the engineers employed.

Differences in employer size between job-seekers and not seekers were not significant if size is rated by engineering employment as in Table 7A. As shown in Table 7B, however, proportions seeking jobs were lower for the biggest companies (over 1,000 **total** employees) and the smallest companies (less than **10 total** employees).

TABLE 7A

SIZE OF *ENGINEERING* WORK FORCE

	Individual Engineers		*Engineering Employer* FORM B Composite	
	FORM A (Comprehensive) (3,081)*	FORM A (Seeking Engineering Employment) (395)*	% Employers (279)*	% Engineer Employee (100,439)
	(% of Respondents)			
> 1000	13	13	5	72
1000-100	26	27	25	23
99-10	30	26	51	5
<10	24	26	19	—
Self Employed	4	4	—	—
No Answer	3	4	—	—

*Actual Count

TABLE 7B

SIZE OF *TOTAL* WORK FORCE

	Individual Engineers		*Engineering Employer* FORM B Composite	
	FORM A (Comprehensive) (3,081)*	FORM A (Seeking Engineering Employment) (395)*	% Employers (273)*	% Engineer Employee (811,628)*
	(% of Respondents)			
> 1000	18	14	33	93
1000-100	33	39	47	7
99-10	26	28	14	—
< 10	15	12	2	—
Self Employed	—	—	—	—
No Answer	8	7	4	—

*Actual Count

Type of Employing Organization

Both the individual engineers and the employers were asked to identify the principal activity of the organization. The distribution of these principal activities is shown in Table 8A.

The correlation among activities is not better than fair. Significant discrepancies exist in representation from government (where individuals were concentrated in federal and employers in state and local), in education (where employers were inadequately sampled), and in research organizations and laboratories (mostly large employers).

Among individual engineers, there is a considerable contrast in the distribution of employment activities among those seeking new engineering employment and those **not** seeking such employment, as shown in Table 8B.

Electrical engineers appear to be under-represented in the sample of individual engineers and over-represented by the sample of employers, as shown in Table 9. Because of the heterogenous nature of AAES, other engineers are over-represented, in part because this survey attempted to get significant samples of the smaller professions, and in part because the response rate of IEEE members to this survey was lower for the other large societies listed in Table 9. Detailed response data appear in Appendix C.

Employers tend not to report or to under-report industrial engineers, whose proportion of returns in the individual engineer sample was reasonably close to representation in AAES by AIIE. It is not clear why the census proportion of industrial engineers is high, but it may represent a catch-all, including manufacturing engineers, such as SME members, who represented 2.5% of the individual engineers' returns, and plant engineers, such as AIPE members, who represented 4.1% of the returns from individual engineers.

As noted previously, industrial and mechanical engineers are more heavily represented among those seeking new engineering jobs, while chemical engineers are less likely to be seeking.

TABLE 8A

ACTIVITY OF EMPLOYING ORGANIZATION

	Individual Engineers	Engineering Employers	
	FORM A (COMPREHENSIVE) (3081)	FORM B (EMPLOYERS— % OF TOTAL) (273)	FORM B (NO. OF ENGRS.— % OF TOTAL) (100439)
Consultants	15.7	10.8	5.6
Federal Govt.	6.6	3.6	3.5
State Govt.	1.9	4.6	4.2
Local Govt.	1.5	5.7	0.9
Educational Inst.	10.0	—	0.8
Electronic Equipt & Comp.	6.0	9.3	20.0
Chemicals & Drugs	5.8	3.6	10.9
Utilities	5.0	10.0	3.5
Aerospace	4.6	5.0	6.9
Engrg. Services	4.2	3.2	5.2
Construction	3.2	3.9	13.0
Metal Products	3.2	3.9	0.3
Petroleum	3.2	1.8	3.2
Ceramics, Glass, Cement	3.2	1.8	0.2
Other Manufacturing	5.5	5.4	1.6
Machinery (other than Elect.)	3.0	3.9	0.5
Research Org. & Labs	2.0	3.6	14.8
Rubber & Plastic Prod.	2.0	1.8	0.1
Food Products	1.2	1.4	0
Communications Serv.	1.1	1.4	0.2
Other (& Not Specified)	11.1	15.3	4.5
TOTAL	100.0	100.0	100.0

TABLE 8B

CONTRAST IN JOB-SEEKING BY EMPLOYING ORGANIZATION
% DISTRIBUTION OF ENGINEERS IN SAMPLE SUBSET

	Seeking	*Not Seeking*	*Overall*	*Points Difference* +	−
Consultants	14.2	15.8	15.7		1.6
Federal Gov't.	8.9	6.4	6.6	2.5	
State Gov't.	1.8	1.8	1.9		
Local Gov't.	2.5	1.3	1.5	1.2	
Educat'l Inst.	9.4	10.3	10.0		0.9
Elect. Equip. & Computers	7.9	5.8	6.0	2.1	
Chemical	4.6	6.0	5.8		1.4
Utilities	3.8	5.3	5.0		1.5
Aerospace	5.6	4.4	4.6	1.2	
Engrg. Services	6.3	3.9	4.2	2.4	
Construction	2.8	3.2	3.2		0.4
Metal Prods (Fab)	1.5	3.5	3.2		2.0
Petroleum	1.8	3.4	3.2		1.6
Ceramics, glass, cement	2.8	3.2	3.2		0.4
Non-elect. machinery	1.8	3.2	5.5		1.4
Resch. organiz. & Labs	1.0	2.1	3.0		1.1
Rubber & Plastic Prods.	1.8	2.0	2.0		0.2
Food Prods.	1.8	1.1	2.0	0.7	
Communicat'n Services	0.5	1.2	1.2		0.7
Other Mfg.	5.3	5.6	1.1		0.3
Other Non Mfg.	13.9	10.5	11.1	3.4	
TOTAL	100.0	100.0	100.0	13.5	13.5

TABLE 9

DISTRIBUTION AMONG BRANCHES OF ENGINEERING

	FORM A Individual Engineers (% of Replies)	Seeking	FORM B Employer Composite (% of Engrs. Employed)	% U.S. Total Engineering Population (*)
Chemical	(AIChE) 8.9	7	9.0	4.3
Civil	(ASCE) 13.1	13	15.8	14.2
Electrical	(IEEE) 13.2	12	27.7	23.1
Industrial	(AIIE) 4.5	6	2.1	15.5
Mechanical	(ASME) 15.0	17	17.0	14.8
Other	45.3	45	28.4	28.1

*Reference: U.S. Bureau of Census Report PC(21)7A, *Occupational Characteristics*, U.S. Government Printing Office, Washington, 1978.

Comments on Samples and Trends

As noted above, significant differences do exist between samples of individual engineer respondents and employers, as well as between individuals seeking new engineering employment and those not seeking such employment.

Some of the factors leading to these differences include the attempt to include a reasonable sample of all AAES member societies, the inevitable self-selection among respondents (both individual and employer), and the large size of many employers.

In addition, as noted in Appendix D1, the current sample make-up does differ significantly from respondents to the 1980 pilot study of demand.

Data have been compared with other studies in Appendix D2, almost all of which are more optimistic, possibly because of earlier timing or selected population niches.

Certainly, therefore, forecasts of demand (like other forecasts) must by interpreted with caution.

Nonetheless, certain implications of this study are worthy of consideration:

1. Generally, growth of demand for engineers in 1982 is below 1981 growth by a significant amount.
2. Strong differences in patterns of demand by region and discipline exist, as might be expected, but differences in employer and individual engineer perceptions of these patterns sometimes differ significantly. Optimism about growth in the profession tends to decline with age.
3. A greater proportion of experienced engineers are seeking employment than employers are planning to hire. It is interesting to note that those seeking include typical proportions both of those who are optimistic that demand is growing and those who anticipate demand will decline.

APPENDICES

A. Survey Instruments

B. Processed Data

1. Individual Engineer Respondents
2. Employer Respondents

C. Participating Technical Societies and Employers

D. Technical Comparisons

1. 1980 Pilot Study of the Demand for Engineers
2. Other Studies
3. Precision of Demand Statistics

APPENDIX A

SURVEY INSTRUMENTS

AAES AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES, INC.
345 EAST 47th STREET • NEW YORK, NEW YORK 10017 • TELEPHONE 212-644-7840

MEMBER SOCIETIES
American Society of Civil Engineers
American Institute of Mining, Metallurgical & Petroleum Engineers, Inc
The American Society of Mechanical Engineers
The Institute of Electrical & Electronics Engineers
American Society for Engineering Education
American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc
American Society of Agricultural Engineers
American Institute of Chemical Engineers
American Society for Metals
National Council of Engineering Examiners
Society of Manufacturing Engineers
National Society of Professional Engineers
National Institute of Ceramic Engineers
Society of Allied Weight Engineers, Inc
Society of Plastics Engineers, Inc
American Society for Quality Control
Standards Engineering Society
American Institute of Industrial Engineers, Inc
Society of Women Engineers
Society of Fire Protection Engineers
American Institute of Plant Engineers
American Nuclear Society
American Academy of Environmental Engineers
American Association of Cost Engineers
System Safety Society
Association of Energy Engineers
American Indian Science & Engineering Society
ASSOCIATE SOCIETIES
Air Pollution Control Association
American Congress on Surveying & Mapping
National Association of Corrosion Engineers
Federation of Materials Societies
REGIONAL SOCIETIES
Western Society of Engineers
The Cleveland Engineering Society
Engineering Society of Detroit
Washington Society of Engineers
Colorado Society of Engineers
Colorado Engineering Council
Engineering Societies of New England, Inc

FORM A

ENGINEERING MANPOWER COMMISSION
(212) 644-7846/47

October, 1981

To Engineering Society Members:

The Engineering Manpower Commission is conducting a study of short-term engineering demand in 1981. This is a follow-up to the 1980 Demand Survey.

We are encouraged by the response to the 1980 survey and in 1981 we expect to increase the number of participants. The survey includes both engineers and employers of engineers.

The **engineers** invited to participate in the survey are members of professional engineering societies. **Employers** invited to participate in the survey are organizations that were suggested to EMC by the engineering societies. In addition, employers who consistently support Engineering Manpower Commission activities are invited to participate. No attempt is made to correlate an individual engineer's response with his or her employers.

Your society has selected you as a participant in the 1981 survey. We sincerely hope you will agree to participate. Please take the time to complete the attached questionnaire and return it as soon as possible. You will notice that we have not asked the society members who participate in the survey to identify themselves, nor have we provided the employer organizations with the names of any of their employees who may have been included in the randomly selected lists of societal members.

The EMC wishes to assure you that this survey form will not be given to or the information contained therein be disclosed to any employment agency or personnel officer. It will be used only as a contribution to the survey data pool containing information furnished by other engineers and engineering employers.

If you have any questions or need assistance, please do not hesitate to call me at the EMC office, (212) 644-7846. Thank you for your cooperation.

Sincerely,

Patrick J. Sheridan
Manager
Manpower Activities

enclosures

FORM A

ENGINEERING MANPOWER COMMISSION
of the
AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES

Survey of Engineering Employment and Demand

Employment Group Number _____ (see instruction A)

Date: _____

1. Employed location zip code: _____ Region Number: _____ (see instruction B).
2. Professional society affiliation(s) _____ _____ _____
3. Year of Bachelor's Degree: _____
   (Please indicate regardless of field of study)
4. Highest degree attained: (Check one)

	Engineering	Other than Engineering
a. PhD	____	____
b. Engineer	____	____
c. Masters	____	____
d. Bachelors	____	____
e. Associate	____	____
f. Other		____

5a. Registered PE? Yes ____ No ____ | 5b. OPTIONAL M ☐ F ☐ Minority _____

6. Employment Status and Prospects:

		Status as of 10/31/80 (check one or more as appropriate)	Status as of 10/31/81 (check one or more as appropriate)	Expected status next year (check one or more as appropriate)
a.	Fully Employed - Engineering Assignment (Including Engineering Management)	☐	☐	☐
b.	Fully Employed - Engineering - related assignment (Sales Engineer, Production Supervisor, etc.)	☐	☐	☐
c.	Fully Employed - Non-engineering Assignment (Sales, Personnel, Accounting, etc.)	☐	☐	☐
	Nature of Non-engineering Work _____			
d.	Partially Employed - Engineering Assignment (25 hours per week or less)	☐	☐	☐
e.	Partially Employed - Engineering - related assignment (25 hours per week or less)	☐	☐	☐
f.	Partially Employed - Non-engineering Assignment	☐	☐	☐
	Nature of Non-engineering Work _____			
g.	Unemployed (not retired)	☐	☐	☐
h.	Retired	☐	☐	☐
i.	Other (please state) _____			

7. Base Annual Salary:

Last year: $_____ (10/31/80) This Year: $_____ (10/31/81) Anticipated 1982: $_____ (10/31/82)

8a. Engineers Employed (Check One)
(In local area for your company or division)

More than 1000 _____
1000 - 100 _____
100 - 10 _____
Under 10 _____
Self Employed _____

8b. Total Employment (Check One)
(In local area for your company or division)

More than 5000 _____
5000 - 500 _____
500 - 50 _____
Under 50 _____

9a. Are you actively seeking new or changed employment? Yes ____ No ____

9b. In the field of engineering? Yes ____ No ____

10. In your opinion, over the next year do you anticipate that engineering employment will:

			REASON: (Check one) if applicable		
(a) In your professional discipline, (such as civil engineering, mechanical engineering, etc.) (Check one)	☐ RISE	→	☐ Planned Growth	—or—	☐ Current Staff Shortages
	☐ REMAIN STEADY	→	☐ Normal Turnover	—or—	☐ Company Consolidation
	☐ DECLINE	→	☐ Economic Uncertainties	—or—	☐ Contract Completion

			REASON: (Check one) if applicable		
(b) In your local area (Check one)	☐ RISE	→	☐ Planned Growth	—or—	☐ Current Staff Shortages
	☐ REMAIN STEADY	→	☐ Normal Turnover	—or—	☐ Company Consolidation
	☐ DECLINE	→	☐ Economic Uncertainties	—or—	☐ Contract Completion

			REASON: (Check one) if applicable		
(c) In your company, government agency, or institution (Check one)	☐ RISE	→	☐ Planned Growth	—or—	☐ Current Staff Shortages
	☐ REMAIN STEADY	→	☐ Normal Turnover	—or—	☐ Company Consolidation
	☐ DECLINE	→	☐ Economic Uncertainties	—or—	☐ Contract Completion

11. Confidence level of your opinion in Question 10: (Check one)

REASONABLY FIRM _____ GOOD ESTIMATE _____ EDUCATED GUESS _____

12. *(Optional)* Other comments on engineering employment relative to demand prospects, quality, etc.:

_____

_____

_____

Thank you for your cooperation. Please return no later than November 15, 1981

(Enclosed envelope)

Engineering Manpower Commission
345 East 47th Street
New York, New York 10017

FORM-A

Survey of Engineering Employment and Demand

INSTRUCTIONS

A. Select Employment Group No. from the following list, and specify **only one group** per form.

01. Aerospace
02. Automotive & Railroad equipment
03. Ceramic products, stone, clay, glass, cement
04. Chemicals, drugs
05. Electrical machinery & equipment
06. Electronic equipment & computers
07. Food products
08. Instruments (precision)
09. Lumber & wood products
10. Machinery (other than electrical)
11. Metal products (fabricated)
12. Metals (basic)
13. Ordnance
14. Paper Products
15. Petroleum
16. Rubber & plastic products (fabricated)
17. Shipbuilding
18. Textile products
19. Business, trade, publishing
20. Communication services
21. Construction
22. Consultants (engineering & architectural)
23. Engineering services (other)
24. Mining
25. Independent research organizations & laboratories
26. Transportation services
27. Electric Utilities
28. Gas Utilities & pipelines
29. Federal Government
30. State Government
31. Local Government
32. Colleges & Universities
33. Technical Institutions & Junior Colleges
34. Professional Societies & Non-Profit Institutions
35. Water Utilities
36. Other Manufacturing
37. Other Non-Manufacturing

B. If data are **primarily** from one or two regional areas, please indicate the appropriate regional number (or numbers).

REGION

1. **New England**
   - Connecticut
   - Maine
   - Massachusetts
   - New Hampshire
   - Rhode Island
   - Vermont
2. **Middle Atlantic**
   - New Jersey
   - New York
   - Pennsylvania
3. **East North Central**
   - Illinois
   - Indiana
   - Michigan
   - Ohio
   - Wisconsin
4. **West North Central**
   - Iowa
   - Kansas
   - Minnesota
   - Missouri
   - Nebraska
   - North Dakota
   - South Dakota
5. **South Atlantic**
   - Delaware
   - District of Columbia
   - Florida
   - Georgia
   - Maryland
   - North Carolina

REGION

5. **South Atlantic** (continued)
   - South Carolina
   - Virginia
   - West Virginia
6. **East South Central**
   - Alabama
   - Kentucky
   - Mississipppi
   - Tennessee
7. **West South Central**
   - Arkansas
   - Louisiana
   - Oklahoma
   - Texas
8. **Mountain**
   - Arizona
   - Colorado
   - Idaho
   - Montana
   - Nevada
   - New Mexico
   - Utah
   - Wyoming
9. **Pacific**
   - Alaska
   - California
   - Hawaii
   - Oregon
   - Washington
10. **U.S. General or Multi-Regions**
11. **Puerto Rico**
12. **Canal Zone**
13. **Non-U.S.**

AAES AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES, INC.
345 EAST 47th STREET • NEW YORK, NEW YORK 10017 • TELEPHONE 212-644-7840

MEMBER SOCIETIES
American Society of Civil Engineers
American Institute of Mining, Metallurgical & Petroleum Engineers, Inc.
The American Society of Mechanical Engineers
The Institute of Electrical & Electronics Engineers
American Society for Engineering Education
American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc.
American Society of Agricultural Engineers
American Institute of Chemical Engineers
American Society for Metals
National Council of Engineering Examiners
Society of Manufacturing Engineers
National Society of Professional Engineers
National Institute of Ceramic Engineers
Society of Allied Weight Engineers, Inc.
Society of Plastics Engineers, Inc.
American Society for Quality Control
Standards Engineering Society
American Institute of Industrial Engineers, Inc.
Society of Women Engineers
Society of Fire Protection Engineers
American Institute of Plant Engineers
American Nuclear Society
American Academy of Environmental Engineers
American Association of Cost Engineers
System Safety Society
Association of Energy Engineers
American Indian Science & Engineering Society
ASSOCIATE SOCIETIES
Air Pollution Control Association
American Congress on Surveying & Mapping
National Association of Corrosion Engineers
Federation of Materials Societies
REGIONAL SOCIETIES
Western Society of Engineers
The Cleveland Engineering Society
Engineering Society of Detroit
Washington Society of Engineers
Colorado Society of Engineers
Colorado Engineering Council
Engineering Societies of New England, Inc.

FORM B

ENGINEERING MANPOWER COMMISSION
(212) 644-7846/47

October, 1981

To All Employer Participants in Engineering Demand Study:

The Engineering Manpower Commission is conducting a study of short-term engineering demand in 1981. This is a follow-up to the 1980 Demand Survey.

We are encouraged by the response to the 1980 survey and in 1981 we expect to increase the number of participants. The survey includes both engineers and employers of engineers.

The **engineers** invited to participate in the survey are members of professional engineering societies. **Employers** invited to participate in the survey are organizations that were suggested to EMC by the engineering societies. In addition, employers who consistently support Engineering Manpower Commission activities are invited to participate. No attempt is made to correlate an individual engineer's response with his or her employers.

Your organization has been selected to participate in the 1981 demand survey. We sincerely hope you will agree to participate. If by chance you are not the proper person in your company to respond to this survey, please forward this correspondence to the responsible party.

The data reported should relate to a definable engineering organization unit. That is, the activity reported must be related to a known number of employed engineers. Accurate data for a small group is preferable to less accurate data for a large group. Large decentralized organizations should send in data for as many groups, divisions or subsidiaries as can be reported. Please use a separate questionnaire for each engineering unit. If you need additional questionnaires simply duplicate the form or call the Engineering Manpower Commission for the number of copies you require.

We recognize that gathering the necessary data and fitting it into a rather inflexible format may be time consuming. In the interest of the accuracy and scope of the survey, we hope that your organization will make a necessary effort to provide "good" data which will be treated in confidence.

If you have any questions or need assistance, please do not hesitate to call me at the EMC office, (212) 644-7846.

Sincerely,

Patrick J. Sheridan

Patrick J. Sheridan
Manager
Manpower Activities

enclosures

FORM-B

ENGINEERING MANPOWER COMMISSION
of the
AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES

SURVEY OF ENGINEERING EMPLOYMENT AND DEMAND

October, 1981
(Confidential Status)

Return by November 15, 1981
(Envelope Enclosed)

Engineering Manpower Commission
345 East 47th Street
New York, New York 10017

Contact Name: _____

Title: _____

Company: _____

Street or P.O. Box: _____

City: _____ State _____ Zip _____ Phone _____

Employment Group No. _____
(See Instruction A)

Region No. _____
(See Instruction B)

Data are: (Please check one)

Nationwide ____ Approx. no. of all employees _____

Regional ____ Approx. no. of all employees _____

Location: (if more than one location please list all and include zip codes)

_____

_____

_____

If breakdowns cannot be given, at least, indicate totals—but above all, answer all **four** categories. We realize that estimates are involved and we assure you of complete confidentiality on the source.

I. NUMBER OF ENGINEERS EMPLOYED
(On payroll 10/31/81—See Instruction C)

		ENGINEERING JOB ASSIGNMENTS (See Instruction D)							
		ChE	Civil	Elec.	Indust.	Mech.	Other Major Displ. *( )	All Other	Total
a.	BS								
b.	MS								
c.	PhD								
d.	No Engr. Degree								
e.	Total Employed								

II. NUMBER OF JOB OPENINGS ON 10/31/81

		ENGINEERING JOB ASSIGNMENTS (See Instruction D)							
		ChE	Civil	Elec.	Indust.	Mech.	Other Major Displ. *( )	All Other	Total
a.	BS								
b.	MS								
c.	PhD								
d.	No Engr. Degree								
e.	Total Openings								

III. NUMBER OF HIRES AND SEPARATIONS

Over the period 10/31/80 to 10/31/81

	ChE	Civil	Elec.	Indust.	Mech.	Other Major Displ. *( )	All Other	Total
a. College Hires								
b. Experienced Hires								
c. Total Hires (a+b)								
d. Total Separations								
e. Net Change (c minus d)								

IV. YOUR FORECAST NUMBER OF HIRES & SEPARATIONS

From 10/31/81 to 10/31/82

	ChE	Civil	Elec.	Indust.	Mech.	Other Major Displ. *( )	All Other	Total
a. College Hires								
b. Experienced Hires								
c. Total Hires (a+b)								
d. Total Separations								
e. Net Change (c minus d)								

***Please Specify; Example: Aero**

V. CONFIDENCE LEVEL OF DATA REPORTED IN QUESTION IV

(Please check one)

REASONABLY FIRM _____ BEST ESTIMATE _____ EDUCATED GUESS _____

VI. COMMENTS RELATING TO DATA REPORTED IN QUESTION IV (OR GENERAL COMMENTS)

_____

_____

_____

_____

_____

_____

FORM-B

Survey of Engineering Employment and Demand

INSTRUCTIONS

A. Select Employment Group No. from the following list, and specify **only one group** per form.

01. Aerospace
02. Automotive & Railroad equipment
03. Ceramic products, stone, clay, glass, cement
04. Chemicals, drugs
05. Electrical machinery & equipment
06. Electronic equipment & computers
07. Food products
08. Instruments (precision)
09. Lumber & wood products
10. Machinery (other than electrical)
11. Metal products (fabricated)
12. Metals (basic)
13. Ordnance
14. Paper Products
15. Petroleum
16. Rubber & plastic products (fabricated)
17. Shipbuilding
18. Textile products
19. Business, trade, publishing
20. Communication services
21. Construction
22. Consultants (engineering & architectural)
23. Engineering services (other)
24. Mining
25. Independent research organizations & laboratories
26. Transportation services
27. Electric Utilities
28. Gas Utilities & pipelines
29. Federal Government
30. State Government
31. Local Government
32. Colleges & Universities
33. Technical Institutions & Junior Colleges
34. Professional Societies & Non-Profit Institutions
35. Water Utilities
36. Other Manufacturing
37. Other Non-Manufacturing

B. If data are **primarily** from one or two regional areas, please indicate the appropriate regional number (or numbers).

REGION

1. **New England**
   - Connecticut
   - Maine
   - Massachusetts
   - New Hampshire
   - Rhode Island
   - Vermont
2. **Middle Atlantic**
   - New Jersey
   - New York
   - Pennsylvania
3. **East North Central**
   - Illinois
   - Indiana
   - Michigan
   - Ohio
   - Wisconsin

REGION

4. **West North Central**
   - Iowa
   - Kansas
   - Minnesota
   - Missouri
   - Nebraska
   - North Dakota
   - South Dakota
5. **South Atlantic**
   - Delaware
   - District of Columbia
   - Florida
   - Georgia
   - Maryland

REGION

5. **South Atlantic** (continued)
   - North Carolina
   - South Carolina
   - Virginia
   - West Virginia
6. **East South Central**
   - Alabama
   - Kentucky
   - Mississippi
   - Tennessee
7. **West South Central**
   - Arkansas
   - Louisiana
   - Oklahoma
   - Texas

REGION

8. **Mountain**
   - Arizona
   - Colorado
   - Idaho
   - Montana
   - Nevada
   - New Mexico
   - Utah
   - Wyoming
9. **Pacific**
   - Alaska
   - California
   - Hawaii
   - Oregon
   - Washington
10. **U.S. General or Multi-Regions**
11. **Puerto Rico**
12. **Canal Zone**
13. **Non-U.S.**

C. Degree level should be reported on basis of college education in engineering. Employees classified as engineers and doing work for which you would normally hire engineering graduates, but who do not hold at least a BS degree in engineering or closely related study, should be reported under "No Engr. Degree". In case of openings, show the degree level that would be *preferred*, assuming manpower is available.

D. Branch of engineering should be reported on the basis of **engineering job assignments,** which may not necessarily be the same as the individual's original education. Group related specialties under the most appropriate major branch. Combine miscellaneous specific fields under the "All Other" column. In the case of openings and new hires, show the specialty that would be *preferred*, assuming manpower is available. If your information is not broken down by discipline, please, at least, indicate totals.

APPENDIX B

PROCESSED DATA

INDIVIDUAL ENGINEER RESPONDENTS

TABLES

B1-A Summary for Participating Societies and Composite for All Individual Respondents

B1-B Median Salaries By Degree Level - Individual Respondents

B1-C Average Salaries in 1981 By Decade Since Bachelor's Degree - Individual Respondents

EMPLOYER RESPONDENTS

TABLES

B2-A Demand For Engineers by Discipline - Employer Respondents

B2-B Demand For Engineers by Region - Employer Respondents

TABLE B1—A

SUMMARY FOR PARTICIPATING SOCIETIES AND COMPOSITE FOR ALL INDIVIDUAL RESPONDENTS

		Composite (3081)*	ASME (461)*	IEEE (406)*	ASCE (403)*	AIChE (273)*	NSPE (242)*
1. Academic & Professional Qualifications (Percent)	B.S.	45.3	53.4	41.4	46.4	44.0	55.8
	M.S.	21.7	24.7	25.1	32.0	27.1	23.6
	Engineer	4.6	2.4	5.2	6.2	3.3	4.6
	Ph.D.	12.1	13.2	15.8	11.2	20.2	5.4
	Assoc.	2.4	0.6	1.0	0.2	0.0	0.4
	Prof. Engr.	46.8	51.2	35.5	77.7	34.4	95.9
2. Employment Status '81 (Percent Fully Employed)	Engineering	74.0	76.1	76.6	82.6	66.3	78.9
	Engrg. Rel.	11.5	10.6	8.6	5.7	15.4	9.9
	Non-Engrg.	5.3	3.5	5.2	2.2	6.6	5.8
3. Primary Location	Region	Mid-Atlantic	Mid-Atlantic	South Atlantic	Pacific	Mid-Atlantic	East North Central
	Percentage	17.7	22.1	22.4	17.4	19.1	19.4
4. Primary Employer Group	Group	Consultants	Consultants	Electronic Equip. & Comp	Consultants	Chemicals & Drugs	Consultants
	Percentage	15.7	15.2	21.9	38.2	31.1	34.3
5. Are Members of an Engineering Work Force Numbering . . .	Force	10-99	100-1000	100-1000	10-99	10-99	<10
	Percentage	29.5	31.4	29.3	33.8	34.8	34.3
6. Reported Median Salaries in 1981	B.S.	$36920	$33523	$37225	$34250	$35900	$39400
	M.S.	$38508	$38617	$39800	$35533	$39650	$36933
	Ph.D.	$43913	$43175	$43200	$42150	$47000	$41600
7. Seeking New Emplmt.	Percentage	14.8	17.4	14.0	13.6	11.0	13.6
Seeking Engrg. Emplmt.	Percentage	15.0	16.7	14.5	15.6	11.4	14.5
8. Employment Trend Viewpoints (Percentage)							
a. Professional Discipline	Rise	37.0	50.3	55.2	36.0	54.2	46.7
	Steady	34.3	32.5	33.3	39.7	30.8	28.1
	Decline	11.6	12.4	8.1	16.1	9.5	16.1
b. Local Area	Rise	37.0	38.6	46.1	30.3	37.7	29.8
	Steady	37.5	33.2	36.2	38.7	41.0	34.7
	Decline	19.7	22.1	13.6	22.6	15.4	25.2
9. Confidence Level in Trend Viewpoint	Firm	29.2	30.2	31.8	27.3	27.5	29.3
	Estimate	43.0	41.2	44.1	40.0	39.9	49.6
	Guess	27.8	28.6	24.1	32.8	32.6	21.1

*Actual count

TABLE B1-A (Cont.)

SUMMARY FOR PARTICIPATING SOCIETIES AND COMPOSITE FOR ALL INDIVIDUAL RESPONDENTS

		Composite (3081)*	AIIE (138)*	NICE (134)*	AIPE (126)*	ASAE (103)*	ANS (86)*
1. Academic & Professional Qualifications	B.S.	45.3	44.9	41.8	45.7	45.6	22.1
	M.S.	21.7	10.1	19.4	6.3	22.3	20.9
	Engineer	4.6	1.4	1.5	9.5	5.8	2.3
	Ph.D.	12.1	5.1	22.4	0.0	18.4	29.1
	Assoc.	2.4	3.6	0.0	14.2	0.0	0.0
	Prof. Engr.	46.8	19.6	18.7	28.4	45.6	25.6
2. Employment Status '81 (Percent Fully Employed)	Engineering	74.0	69.6	68.7	74.0	69.9	80.2
	Engrg. Rel.	11.5	13.0	14.9	19.7	10.7	9.3
	Non-Engrg.	5.3	10.9	3.7	3.9	6.8	8.1
3. Primary Location	Region	Mid-Atlantic	East North Central	East North Central	East North Central	West North Central	Pacific
	Percentage	17.7	20.3	23.1	39.4	25.2	23.3
4. Primary Employer Group	Group	Consultants	Electronic Equip. & Comp.	Ceramics, Stone, Glass & Cement	Chemicals & Drugs	Colleges & Univ.	Federal Government
	Percentage	15.7	5.8	58.2	12.6	22.3	17.4
5. Are Members of an Engineering Work Force Numbering . . .	Force	10-99	10-99	10-99	10	10-99	100-1000
	Percentage	29.5	36.2	33.6	47.2	35.9	41.9
6. Reported Median Salaries in 1981	B.S.	$36920	$28833	$37000	$35000	$29500	$44000
	M.S.	$38508	$30000	$38200	$32500	$38000	$41167
	Ph.D.	$43913	$36000	$45000	—	$37500	$42350
7. Seeking New Emplmt.	Percentage	14.8	19.6	15.7	19.7	8.7	22.1
Seeking Engrg. Emplmt.	Percentage	15.0	17.4	14.9	18.9	6.8	22.1
8. Employment Trend Viewpoints (Percentage)							
a. Professional Discipline	Rise	37.0	66.7	48.5	45.7	32.0	54.6
	Steady	34.3	26.8	34.3	46.4	46.6	27.9
	Decline	11.6	3.6	9.7	7.1	18.4	16.3
b. Local Area	Rise	37.0	45.6	29.1	44.1	17.5	44.2
	Steady	37.5	36.2	39.6	39.4	53.4	23.3
	Decline	19.7	15.9	22.4	15.7	26.2	31.4
9. Confidence Level in Trend Viewpoint	Firm	29.2	37.7	23.1	25.4	21.4	27.9
	Estimate	43.0	42.8	38.8	48.4	42.7	45.4
	Guess	27.8	19.6	38.1	26.2	35.9	26.7

*Actual count

These tables are included for completeness but should be interpreted with great caution. For a thorough report on engineers' salaries, the reader is referred to *Engineers' Salaries: Special Industry Report* published by the Engineering Manpower Commission.

TABLE B1-B

MEDIAN SALARIES BY DEGREE LEVEL

For All Salaries Reported from 0-50 Years Since B.S.

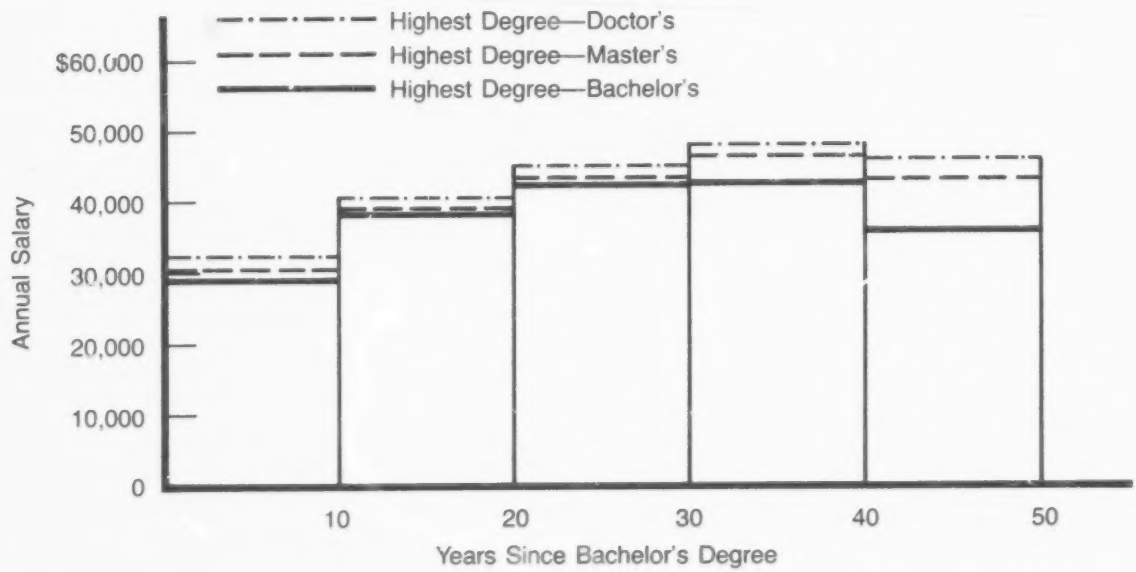
	1980	1981	1982*	% Increase 1981-1982
	(2355)	(2396)	(2278)	
Bachelor's	$34,561	$36,920	$40,072	8.5%
Master's	$36,684	$38,508	$41,933	8.9%
Engineer's	$32,750	$33,529	$36,750	9.6%
Doctor's	$40,736	$43,913	$48,510	10.5%

( ) denotes negative value

* Estimated by Respondents

TABLE B1-C

AVERAGE SALARIES IN 1981 BY DECADE SINCE BACHELOR'S DEGREE



Counts of Returns						
	BS	501	262	271	228	40
	MS	141	181	148	121	29
	PhD	26	127	124	52	19

NOTE: Sample sizes in the 40-50-Years-Since-B.S. groups is small.

TABLE B2-A

DEMAND FOR ENGINEERS BY BRANCH OF ENGINEERING ALL EMPLOYMENT GROUPS COMBINED

NUMERICAL DATA

	NUMBER OF ENGINEERS EMPLOYED AS OF 10/31/81					NUMBER OF OPENINGS AS OF 10/31/81					PAST 12 MO. 10/31/80—10/31/81 HIRES			SEP'S	NET	FORECAST 10/31/81—10/31/82 HIRES			SEP'S	NET
	Total	BS	MS	PhD	No Degree	Total	BS	MS	PhD	No Degree	College	Experience	Total			College	Experience	Total		
Chemical	**9030**	6275	1694	812	249	**636**	428	114	74	20	383	834	1217	756	**461**	343	554	897	690	**207**
Civil	**15840**	11000	2264	257	2319	**1279**	1061	127	14	77	867	1194	2061	1203	**858**	665	948	1613	952	**661**
Electrical	**27827**	15137	7288	1975	3427	**2867**	1738	591	206	332	1906	1908	3814	2137	**1677**	1793	2113	3906	1970	**1936**
Industrial	**2141**	1316	385	44	396	**269**	170	41	25	33	129	95	224	167	**57**	164	102	266	123	**143**
Mechanical	**17117**	17445	3264	732	1676	**1823**	1276	286	66	195	1069	1570	2639	1319	**1320**	965	1495	2460	1194	**1266**
All Other	**28484**	12147	6210	2157	7970	**2456**	1088	547	173	648	1119	5754	6873	3247	**3626**	1278	4908	6186	3469	**2717**
TOTAL	**100439**	57320	21105	5977	16037	**9330**	5761	1706	558	1305	5473	11355	16828	8829	**7999**	5208	10120	15328	8398	**6930**

PERCENTAGE DATA

	NUMBER OF ENGINEERS EMPLOYED AS OF 10/31/81					NUMBER OF OPENINGS AS OF 10/31/81					*PAST 12 MO. 10/31/80—10/31/81 HIRES			SEP'S	NET	**FORECAST 10/31/81—10/31/82 HIRES			SEP'S	NET
	Total	BS	MS	PhD	No Degree	Total	BS	MS	PhD	No Degree	College	Experience	Total			College	Experience	Total		
Chemical	**100**	69.5	18.8	9.0	2.8	**7.0**	6.8	6.7	9.1	8.0	4.5	9.7	14.2	8.8	**5.4**	3.8	6.1	9.9	7.6	**2.3**
Civil	**100**	69.4	14.3	1.6	14.6	**8.1**	9.6	5.6	5.4	3.3	5.8	8.0	13.8	8.0	**5.8**	4.2	6.0	10.2	6.0	**4.2**
Electrical	**100**	54.4	26.2	7.1	12.3	**10.3**	11.5	8.1	10.4	9.7	7.3	7.3	14.6	8.2	**6.4**	6.4	7.6	14.0	7.1	**7.0**
Industrial	**100**	61.5	18.0	2.1	18.5	**12.6**	12.9	10.6	56.8	8.3	6.2	4.6	10.8	8.0	**2.1**	7.7	4.8	12.4	5.7	**6.7**
Mechanical	**100**	66.9	19.1	4.3	9.8	**10.6**	11.1	8.8	9.0	11.6	6.8	9.9	16.7	8.3	**8.4**	5.6	8.7	14.4	7.0	**7.4**
All Other	**100**	42.6	21.8	7.6	28.0	**8.6**	9.0	8.8	8.0	8.1	4.5	23.1	27.6	13.1	**14.6**	4.5	17.2	21.7	12.2	**9.5**
TOTAL	**100**	57.1	21.0	6.0	16.0	**9.3**	10.1	8.1	9.3	8.1	5.9	12.3	18.2	9.6	**8.6**	5.2	10.1	15.3	8.4	**6.9**

*Percentages are calculated as follows: subtract net change in past 12 months from number employed as of 10/31/81; divide number hired (or separated) in past 12 months by this difference. Multiply this figure by 100. For example, past-12-month-chemical-college-hires-percentage = [383/(9030−461)] x 100 = 4.5%.

**Percentages are calculated as follows: number forecast divided by number employed as of 10/31/81; multiply by 100. For example, forcast-chemical-college-hires-percentage= (343/9030) x 100 = 3.8%.

TABLE B2—B

DEMAND FOR ENGINEERS BY REGION
ALL EMPLOYMENT GROUPS AND DISCIPLINES COMBINED

NUMERICAL DATA

	NUMBER OF ENGINEERS EMPLOYED AS OF 10/31/81					NUMBER OF OPENINGS AS OF 10/31/81					PAST 12 MO. 10/31/80—10/31/81 HIRES			SEP'S	NET	FORECAST 10/31/81—10/31/82 HIRES			SEP'S	NET
	Total	BS	MS	PhD	No Degree	Total	BS	MS	PhD	No Degree	College	Experience	Total			College	Experience	Total		
U.S. Gen. & Multi-Reg.	**37893**	21569	9184	2765	4375	**4651**	2585	993	384	689	2782	7203	9985	3995	**5990**	2387	5955	8342	4136	**4206**
Pacific	**29059**	14514	6435	1814	6296	**2163**	1161	464	112	426	1198	2340	3538	2698	**840**	1161	2056	3217	2642	**575**
South Atlantic	**4017**	2446	440	67	1064	**371**	300	28	13	30	147	196	343	273	**70**	244	395	639	232	**407**
Middle Atlantic	**6978**	4686	1312	236	744	**273**	220	36	11	6	130	333	463	369	**94**	351	730	1081	377	**704**
West No. Central	**2843**	1741	237	26	839	**176**	164	6	0	6	142	84	226	211	**15**	118	90	208	202	**6**
New England	**2140**	1017	231	201	691	**98**	65	17	7	9	45	109	154	191	**(37)**	33	101	134	81	**53**
East No. Central	**7902**	5598	1283	330	691	**536**	479	23	4	30	366	316	682	460	**222**	355	257	612	283	**329**
Mountain	**3431**	1793	1120	398	120	**163**	137	31	1	0	173	240	413	144	**269**	94	117	211	128	**83**
West So. Central	**4157**	2787	763	131	476	**581**	443	96	26	16	360	214	574	280	**294**	330	272	602	222	**380**
East So. Central	**2019**	1169	100	9	741	**318**	213	12	0	93	130	320	450	208	**242**	135	147	282	95	**197**

PERCENTAGE DATA

	NUMBER OF ENGINEERS EMPLOYED AS OF 10/31/81					NUMBER OF OPENINGS AS OF 10/31/81					*PAST 12 MO. 10/31/80—10/31/81 HIRES			SEP'S	NET	**FORECAST 10/31/81—10/31/82 HIRES			SEP'S	NET
	Total	BS	MS	PhD	No Degree	Total	BS	MS	PhD	No Degree	College	Experience	Total			College	Experience	Total		
U.S. Gen. & Multi-Reg.	**100**	56.9	24.2	7.3	11.5	**12.3**	6.8	2.6	1.0	1.8	8.7	22.6	31.3	12.5	**18.8**	6.3	15.7	22.0	10.9	**11.1**
Pacific	**100**	49.9	22.1	6.2	21.7	**7.4**	4.0	1.6	0.4	1.5	4.2	8.3	12.5	9.6	**3.0**	4.0	7.1	11.1	9.1	**2.0**
South Atlantic	**100**	60.9	10.9	1.7	26.5	**9.2**	7.5	0.7	0.3	0.7	3.7	5.0	8.7	6.9	**1.8**	6.1	9.8	15.9	5.8	**10.1**
Middle Atlantic	**100**	67.2	18.8	3.4	10.7	**7.8**	6.3	1.0	0.0	0.0	1.9	4.8	6.7	5.4	**1.4**	5.0	10.5	15.3	5.4	**10.1**
West No. Central	**100**	61.2	8.3	0.9	29.5	**6.2**	5.8	0.2	0.0	0.2	5.0	3.0	8.0	7.5	**0.5**	4.2	3.2	7.3	7.1	**0.2**
New England	**100**	47.5	10.8	9.4	32.3	**4.6**	3.0	0.8	0.3	0.4	2.1	5.0	7.1	8.8	**(1.7)**	1.5	4.7	6.3	3.8	**2.5**
East No. Central	**100**	70.8	16.2	4.2	8.7	**6.8**	6.1	0.3	0.0	0.4	4.3	4.1	8.9	6.0	**2.9**	4.5	3.2	7.7	3.6	**4.2**
Mountain	**100**	52.2	32.6	11.6	3.5	**4.8**	3.8	0.9	0.0	0.0	5.5	7.6	13.1	4.6	**8.5**	2.7	3.4	6.1	3.7	**2.4**
West So. Central	**100**	67.0	18.4	3.2	11.4	**14.0**	10.6	2.3	0.6	0.0	9.3	5.5	14.8	7.2	**7.6**	7.9	6.5	14.5	5.3	**9.1**
East So. Central	**100**	58.9	5.0	0.4	36.7	**15.8**	10.5	0.6	0.0	4.6	7.3	18.0	25.3	11.7	**13.6**	6.7	7.3	14.0	4.7	**9.8**

( ) denotes negative value

*Percentages are calculated as follows: subtract net change in past 12 months from number employed as of 10/31/81; divide number hired (or separated) in past 12 months by this difference. Multiply this figure by 100. For example, past 12-month-U.S. Gen.-College-hires-percentage = [2782/(37893-5990)] x 100 = 8.7%.

**Percentages are calculated as follows:
divide number forecast by number employed as of 10/31/81; multiply by 100. For example, forecast-U.S. Gen.-college-hires-percentages = (2387/37893) x 100 = 6.3%

APPENDIX C

PARTICIPATING TECHNICAL SOCIETIES
PARTICIPATING EMPLOYERS

TABLES

C1-A Participating Technical Societies

C1-B Society Response Statistics

C2 Participating Employers

TABLE C1-A

PARTICIPATING SOCIETIES

IEEE	Institute of Electrical and Electronic Engineers
ASME	American Society of Mechanical Engineers
ASCE	American Society of Civil Engineers
SME	Society of Manufacturing Engineers
AIChE	American Institute of Chemical Engineers
ASQC	American Society for Quality Control
NSPE	National Society of Professional Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
AIIE	American Institute of Industrial Engineers
ASM	American Society of Metals
SPE	Society of Plastics Engineers
ANS	American Nuclear Society
ASEE	American Society for Engineering Education
NCEE	National Council of Engineering Examiners
ASAE	American Society of Agricultural Engineers
AIPE	American Institute of Plant Engineers
AACE	American Association of Cost Engineers
AEE	Association of Energy Engineers
SWE	Society of Women Engineers
NICE	National Institute of Ceramic Engineers
AAEE	American Academy of Environmental Engineers
SSS	System Safety Society
SES	Standards Engineering Society

TABLE C1-B

SOCIETY RETURN STATISTICS

Society	$4\sqrt{n}$ *	# Returns	% Returns	Total Membership	% Represented
IEEE	1,447	406	28.1	130,869	0.31
ASME	1,073	461	43.0	71,899	0.64
ASCE	1,023	403	39.4	65,455	0.62
SME	835	71	8.5	43,538	0.16
AIChE	809	273	33.7	40,880	0.67
ASQC	663	61	9.2	27,450	0.22
NSPE	629	242	38.5	24,745	0.98
ASHRAE	594	86	14.5	22,017	0.39
AIIE	569	138	24.2	20,258	0.68
ASM	541	76	14.0	18,314	0.42
SPE	522	76	14.6	17,021	0.45
ANS	402	86	21.4	10,116	0.85
ASEE	377	48	12.7	8,894	0.54
NCEE	354	2	0.6	2,819	0.03
ASAE	307	111	2.6	5,886	0.89
AIPE	284	127	44.7	5,040	2.52
AACE	231	37	16.0	3,338	1.11
AEE	200	2	1.0	2,500	0.08
SWE	197	24	12.2	2,417	0.99
NICE	171	134	78.3	1,825	7.34
AAEE	161	6	3.8	1,630	0.37
SSS	121	24	19.8	916	2.62
SES	100	8	8.0	611	1.31

*n = total membership

PARTICIPATING EMPLOYERS

Aeronica Inc.
Alabama Power Co.
Allendale Mutual Insurance Co.
American Enka Co.
Arkansas State Hwy & Transportation Dept.
Artisan Industries Inc.
Automated Packaging Systems Inc.
Bailey Controls Co.
Baker McHenry Welch
Bank Building Corp.
Bechtel Power Corp.
Belcher Oil Corp.
Bell Laboratories
Bendix Corp.
Benedict, Bowman, Craig, & Moos
Bernard Division/Dover Corp.
Booz, Allen & Hamilton
Briley, Wild & Assoc.
Brunswick Corp.
Burgess & Niple Ltd.
Burlington Industries
Burlington Northern Railroad
Burns & McConnell
C.A.I.—Div. of Recon Optical
Carolina Telephone & Telegraph
Central Nebraska Public Power & Irrigation District
Century Brass Products
CH2M Hill Inc.
Charles River Assoc.
Chesapeake Corp. of Virginia
Ciba-Geigy Corp.
City of Cincinnati Dept. of Engineers
City & County of San Francisco Utilities Engineering Bureau
City of Dayton Dept. of Water
City of Dayton Div. of Engineering
City of Grand Rapids—City Engrg Office
City of Kansas City—City Engr.
City of Milwaukee Bureau of Engineers
City Public Service
City of Public Service Board
City of St. Paul Public Works Dept.
City of Tulsa
Computer Sciences Corp. Systems Div.
Connecticut & Water Co.
Conserv Inc.
Conwed Corp.
Cooper Industries Inc.—Cooper Energy Svcs.
County of Greenville
Crown International
Daily & Assoc.
Denver Water Dept.
Dept. of Transport. & Devel. (Baton Rouge)
Dictaphone Res. & Sev.
Dobay Packaging Machinery
Dresser Engrg. Co.
Duo Fast Corp.
Easy Bay Municipal Utility District
Eaton Corp.
E.B. Industries Inc.
E. I. DuPont
Electric Power Board of Chattanooga
Electro Corp.
Emerson Electric Co —Micro Devices Div.
Equity Oil Co.
Evans & Sutherland Computer Corp.
Fairbrother & Gunther, Inc.
Fermi Nat'l. Accel. Lab.
Ferro Corp. Tech. Cntr.
Fluor Corp.
FMC Corp.
Gast Mfg. Corp.
Gehl Co.
General Dynamics
General Electric Co.
Georgia Dept. of Transportation
Gettys Mfg. Co. Inc.
Glastic Corp.
The Halcon SD Group, Inc.
Halter Marine Inc.
Harza Engineering Co.
Hiram Walker & Sons Inc.
Homer L. Chastein & Assoc.
Hoover Co.
Howard Needles Tammen & Bergendoff
Hughes Aircraft & Co.
Hussey Manufacturing Co., Inc.
Idaho Power Co.
Indiana & Michigan Electric Co.
Ingalls Shipbldg Div.—Letton Systems
International Jensen Inc.
Intertherm Inc.
Inst. of Gas Technology
Iowa Electric Light & Power Co.
Iowa Ill. Gas & Elec.
Ironsides Co.
Jet Propulsion Laboratory
Kaman Aerospace Corp.
Lakeside Bridge & Steel Co.
Leigh Products Inc.
Lincoln Telephone & Telegraph
Lockheed Eng. & Mgt. Ser.
Lone Star Gas Co.
Los Angeles County Flood Control District
Markem Corp.
Massachusetts Mutual Life Insurance Co.
McNamee, Porter & Seeley
Medusa Corp.
Minnesota Power & Light
Missouri Pacific Railroad Co.
Missouri Highway & Transportation Dept.
Modular Power Systems Inc.
Montana Power Co.
NASA Lewis Research Cntr.
National Lead Co.
Nat'l Rural Utilities Cooperative Finance Corp.
Nat'l Steel & Shipbuilding Co.
Naval Ocean Systems Cntr.
Naval Post Grad School
Nebraska Public Power District
North Dakota State Highway Dept.
Northrop Corp.
Northwest Electric
Noxell Corp.
NRC Inc.
Nuclear Data Inc.
Offshore Power Systems
Oilgear Co.
Olga Co.
Omaha Public Power District
One Hundred Combat Support Group

Pako Corp.
Pan Am World Airways
Panhandle Eastern Pipe Line Co.
Parsons Brinckerhoff Quade & Douglas Inc.
PCR Inc.
Peabody Process Systems Inc.
Pearl Brewing Co.
Pellerin Nilner Corp.
Pendleton Construction Corp.
Pennsylvania Dept. of Transportations
Perkin-Elmer Corp.
Peterson Mfg. Co.
Phelps Dodge Magnet Wire Co.
Philips Laboratories
Pittsburgh Pacific Co.
Port of San Diego
PPG Industries
Prestolite Electronics Division
PT Components, Stearns Div.
Public Utility District of Grant County
Rapistan Inc.
RE/Spec. Inc.
Reflections Inc.
Rexnard Bearing Div.
Reuter-Stokes, Inc.
Robert Bosch's Sales Corp.
Roper Pump Co.
Rust Engineering Co.
Sandia Laboratories
Sargent & Lundy
Savannah Elec. & Power Co.
Schaffer, Johnston, Lichtenwalter & Assoc.
Schnabel Foundation
Sealed Power Corp.
Simmonds Precision, ESD
Solar Turbines Inc.
South Central Bell Telephone Co.
Southeastern Illinois Electric Coop Inc.
Southwest Research Inst.
Southwind Division—Stewart Warner Corp.
Spalding
Sperry Flight System
Springfield Utility Board
St. Joseph Light & Power
St. Paul Water & Utility
Standard Oil Co. of Indiana
Stanley Consultants
State of Alabama Hwy. Dept.
State of Indiana Dept. of Highways
State of Montana Dept. of Highways
State of N. Carolina Dept. of Transportation
State of Utah Dept. of Transportation
State of Virginia Dept. of Hwys. & Transportation
Summit County Engrs. Office
Tampa Electric Co.
Telcom Inc.
Teledyne Avionics
Tillet & Assoc. Inc.
Timken Co.
Transco Exploration Co.
TRW Controls
Turner, Collie & Braden Inc.
UNC Nuclear Industries
US Air Force
US Forest Service-Angeles Nat'l Forest
US Public Health Serv. Indian Health Service
Van Zelm, Heywood & Shadford Inc.
Vermeer Mfg. Co.

APPENDIX D

TECHNICAL COMPARISONS

TABLES

D1 1980 Pilot Study of the Demand for Engineers

D2 Other Studies

D3 Precision of Demand Statistics

APPENDIX D1
COMPARISON WITH 1980 PILOT STUDY OF THE DEMAND FOR ENGINEERS

This study is a successor to the 1980 Pilot Study of the Demand for Engineers, dated April, 1981 which reported actual data as of May 1, 1980. This study reports data as of October 1, 1981, so that forecasts made by the pilot study are five months behind the actual data reported in this study. This timing difference is accentuated by employer hiring practices. A May forecast is more likely to be accurate for intentions of hiring new graduates and an October forecast is more likely to be accurate for the experienced engineer. In addition, sampling of the pilot study was based on Engineers' Joint Council (EJC) membership. EJC has since been merged into AAES, and a broader sample of societies was obtained. Appreciable differences in societal response rates were also experienced, so that considerable differences in make-up of sample resulted.

Almost four times as many companies were sampled in 1981, so that employers common to both studies represent a relatively small proportion of the response.

For all these reasons, comparisons shown in the following tables should be interpreted with considerable caution.

Table D1-A compares the major features of sample make-up for the two surveys.

The current study has a higher representation of individuals from education, and thus a higher proportion of Ph.D.'s.

Response rates in this study were appreciably higher from Western states.

The pilot study undersampled mechanical engineers and this has been corrected in the current study. However, response rates from electrical engineers was heavier than in the pilot study.

Age distribution (years since B.S.) was more even in this study than in the pilot study, possibly reflecting the broader distribution of professional societies.

Table D1-B shows a significant increase in the proportion of engineers expecting a decline in demand in the current study. As noted above, differences in demography in the surveys makes caution adviseable in interpreting these implications.

Table D1-C compares forecasts of employment made by employers for May 1, 1980 to May 16, 1981 in the pilot study with reported employment October 1, 1980 to October 1, 1981 and with their forecasts for October 1, 1981 to October 1, 1982. Separations were consistently higher than forecast. As expected, total hiring and net change in "all other" were particularly strong. College hiring was weaker than expected. However, forecasts for total hiring and net change were conservative in light of actual experience.

For the most part, the forecasts for future hiring (80-81) in the pilot study are closer to forecasts for future hiring (81-82) in the present study than to reported hiring.

In Table D1-D the percent change from forecast to actual is displayed for five companies that reported in both the pilot study and the present study. For example, Company A hired 177% of its forecast, and its net change in engineering employment was 283% of its forecast. These companies account for, in aggregate, about 90% of the hiring reported in the pilot study, and represent employer's distributed by industry, geography, and size.

It is clear that forecasts do not correlate with reported hiring, either because of timing differences or because of the economic turmoil of the last two years, in addition to the expected degree of inaccuracy of the initial forecast. This discrepancy is unexpected when compared with data reported by Brach and Mansfield, shown in Table D1-E.

TABLE D1-A

INDIVIDUAL ENGINEER SAMPLE COMPARISON

	1981 DEMAND SURVEY	1980 PILOT SURVEY
1. Survey statistics		
Mailing	11,610	5,106
Valid Returns	3,081	1,426
Return %	27	28
2. Education (adjusted for non-response), %		
B.S.	52	55
M.S. or Engr.	30	31
Ph.D.	14	10
Assoc. or No Degree	4	4
3. Geography, %		
Eastern	69	73
Western or other	31	27
4. Employer size, %		
Over 100 Engineers	39	39
5. Employer Type, %		
Gov't.	10	12
Educ. Inst.	10	6
Stone, Clay, Glass	3	1
Resch. Organization	2	4
6. Professional Affiliation, %		
Chemical	9	11
Civil	13	19
Electrical	13	18
Industrial	4	7
Mechanical	15	8
Other	46	37
7. Years Since B.S., %		
0-10	28	44
11-20	25	21
21-30	25	19
31-40	18	12
41-50	4	4

TABLE D1-B

COMPARISON OF FUTURE EXPECTATIONS

(Percents of Individual Engineers)

DEMAND EXPECTATIONS

	INCREASE EXPECTED		*DECREASE EXPECTED*	
	1982 SURVEY (10-1-81 to 10-1-82)	1981 PILOT (5-1-80 to 5-1-81)	1982 SURVEY (10-1-81 to 10-1-82)	1981 PILOT (5-1-80 to 5-1-81)
In Profession	49	52	12	9
In Region	37	35	20	16
In Organization	35	37	16	14

SEEKING ENGINEERING EMPLOYMENT

1982 SURVEY	1981 PILOT
15%	13%

TABLE D1-C

FORECASTS BY EMPLOYER

	PILOT STUDY					CURRENT STUDY									
	Forecast % Employment Change 5/1/80—5/1/81					Reported % Employment Change 10/31/80—10/31/81					Forecast % Employment Change 10/31/81—10/31/82				
	HIRES					HIRES					HIRES				
	College	Experienced	Total	SEPS	NET	College	Experienced	Total	SEPS	NET	College	Experienced	Total	SEPS	NET
Chemical	7.1	2.7	9.8	6.3	3.5	4.5	9.7	14.2	8.8	5.4	3.8	6.1	9.9	7.6	2.2
Civil	5.9	5.6	11.5	1.9	4.6	5.8	8.0	13.8	8.0	5.7	4.2	6.0	10.2	6.0	4.2
Electrical	8.4	6.5	14.9	6.8	8.1	7.3	7.8	14.6	8.2	6.4	6.4	7.6	14.0	7.1	7.0
Industrial	6.1	5.2	11.3	7.8	3.5	6.2	4.6	10.8	8.0	2.7	7.7	4.8	12.1	5.7	6.7
Mechanical	7.9	5.6	13.5	7.5	5.9	6.8	9.9	16.7	8.3	8.4	5.6	8.7	14.4	7.0	7.4
All Other	5.9	10.9	16.9	9.5	7.3	4.5	23.1	27.6	13.1	14.6	4.5	17.2	21.7	12.2	9.5
TOTAL	**6.8**	**7.1**	**13.9**	**7.8**	**6.1**	**5.9**	**12.3**	**18.2**	**9.6**	**8.6**	**5.2**	**10.1**	**15.3**	**8.4**	**6.7**

TABLE D1-D

VARIABILITY OF EMPLOYER FORECASTS
% CHANGE, 5/1/80 TO 5/1/81 FORECASTS VS 10/31/80 TO 10/31/81 ACTUAL

	Co. A	Co. B	Co. C	Co. D	Co. E
Total Hires	177	(36)	(100)	44	(20)
Net Change	283	(73)	84	288	(54)

( ) denotes negative value

TABLE D1-E

MEAN PERCENTAGE ERROR IN A FIRM'S FORECAST OF ITS ENGINEERING EMPLOYMENT 1957-1976*

	Forecasting Interval, Years	
	0.5	2
Industry	%	%
Aerospace	10.3	15.9
Electronics	4.6	12.4
Chemical	3.2	5.7
Petroleum	2.8	5.5

*Brach, F. and Mansfield, E. "Firm's Forecasts of Engineering Employment" *Management Science*, Vol. 28, No. 2, February, 1982.

APPENDIX D2
COMPARISONS WITH OTHER STUDIES

This survey, probably because of timing, appears to be less optimistic than other studies shown in Table D2. Also, because of its multi-industry coverage, results would differ from those dealing with a more tightly defined industry or sample.

- AIChE forecasts 7% and 5.8% increases for new chemical engineers in 1981 and 1982 vs 4.2% and 3.8% reported in this survey.
- Unemployment for physicists, including those employed as engineers, was reported by AIP at about 1% in 1979 and 1980. This survey of engineering society members reports about 0.4%.
- AEA projected growth in engineering needs of the electronic industry of about 13–14% in the 1981–1983 period. Overall, this survey reports that for all electrical engineers, demand in 1982 will be 7%. The AEA survey, of course, antedated the current downturn in the industry, and was geographically concentrated in the Pacific and New England regions. However, individual engineers in the electronics/computer industry are more inclined to see rising demand than engineers in the utility and electrical equipment industries.
- Cahner's Publishing Company's projection of the Deutsch, Shea and Evans Index shows an overall 9.4% rise in hiring activity from October, 1981 to October, 1982. Overall, this survey projects an 8.9% decrease in hiring activity for the year ending October, 1981 to the year ending October, 1982 (15,328 hires vs. 16,828 hires). However, integration of the Cahner index would give more closely comparable results.
- The Endicott and Fox-Morris surveys both appear more optimistic than this survey, probably because of timing differences.
- The College Placement Council forecast an increase of over 12% in 1982 for college hiring vs. a 4% decrease in the number to be hired anticipated by the employers in this survey.

TABLE D2

RESULTS OF OTHER STUDIES

STUDY	METHODOLOGY	FINDINGS
AIChE Personnel Supply and Demand Committee, "Supply/ Demand Outlook for Chemical Engineers," *CEP* Vol. 78, No. 2, February, 1982.	25 company survey of 1975-1980 history and 1981-1986 forecast of new graduate demand for ChE's. Data as of 5/29/81.	New graduate demand to *decrease* 7% in 1981 and **increase** 5.8% in 1982.
Porter, B. and Czujko, R., "Society Membership 1980: Profile: Stability & Change," *AIP REPORT.* Institute of Physics, 1981.	Random sample and resample of AIP members in 1979 & 1980.	16% of members surveyed identified themselves as engineers. Primarily Ph.D.'s. Unemployed seeking employment was 2%.
American Electronics Association, "Technical Employment Projections of Professionals and Paraprofessionals," **AEA,** May, 1981.	Survey of projections from 554 facilities operated by company members of AEA. February–March 1981. Survey respondents concentrated in California and Massachusetts.	Industry estimated increase of 18.5% in professionals in 1981, average compound growth 13.3% 1980-1983 and 13.8% 1981-1982. Growth projections per year are: electrical/electronic 13.0 mechanical 12.8 mfg./industrial 14.5
Forecasts quoted in SMC's, *Manpower Comments,* Jan-Feb 1982		
A. Cahner's Publishing Co., "Deutsch Shea & Evans High Technology Recruitment Index."	Econometric model, assumes economic growth by mid-1982 and an upturn in high-technology business.	October, 1981 Index of 128%. Projects recovery to about 140% in October, 1982 after drop to about 117 in December, 1981.
B. Endicott Report from Northwestern University	Survey of 242 firms.	1982 hiring of (new) engineering bachelors degree recipients projected to rise 21%; hiring of new master's degree recipients projected to rise 25%.
C. Fox-Morris Survey	Survey of 3200 employers	Engineering demand up 16.1%, with those with 2-5 years experience most in demand.
Fowler, E.M., "Engineer Shortage? Well, That Depends," *New York Times,* 3/28/82	Peterson's survey of 1200 employers in fall, 1981.	High mention of openings in mechanical, electrical, and electronics engineering.
Forecast quoted by Vetter, B., *Supply and Demand for Scientists and Engineers,* SMC, January, 1982.		
College Placement Council, "Recruiting '82," October, 1981.	Survey of 551 employing organizations in private sector.	New hires in engineering in 1982 will increase by 12% at bachelor's, 32% at master's, and 37% at doctorate levels.

APPENDIX D3
PRECISION OF DEMAND STATISTICS

A number of approximate statistical procedures were applied to the survey data in order to get some notions of precision and to clarify the importance of factors affecting demand. Procedures were limited by time and software available to meet the EMC goal of timely publication.

The reproducibility of data subsets is illustrated in Table D3-1. The 3,081 data sets from individual respondents were split into five subsets and statistics for each subset were computed. Table D3-1 provides a basis for estimating total variability of the data.

Separately, the variability due to societies, years since B.S., and organization size was estimated.

As may be noted by comparing Table D3-3 (and correcting for sizes of subsets), organization size does not appear significant on several key demand variables.

On the other hand, society and years since B.S significantly affect these variables. Tables D3-2A and D3-2B show alternate groupings of societies within which *no* statistically significant difference was indicated [using Tukey's Wholly Significant Difference (WSD) procedure]. Since brackets of ultimate groupings overlap to some extent, there are no unique groupings, but, certainly, very clear differences exist between societies with low and high demand optimism and between societies with low and high tendencies to seek new employment.

As noted in the discussion of Table 2A in the text, the tendency toward a belief in rising employment decreases with years since B.S., as does the tendency to seek new employment; these are also indicated by the statistical procedures.

Data are, of course, available for further statistical analyses, and some of these analyses may be used for guidance in future studies. Further detail on these may be obtained from the EMC.

TABLE D3-1

COMPARISON OF 5 SAMPLE SUBSETS

A. Professional Demand Proportion

Subset	Rise	Steady	Decline	NA	n
1	47.81	35.01	11.83	5.35	617
2	50.16	35.39	9.41	5.03	616
3	48.38	34.10	12.01	5.52	616
4	50.81	31.01	12.99	5.20	616
5	47.40	36.20	11.53	4.87	616
$\bar{x}$	48.912	34.342	11.554	5.194	
s	1.495	2.010	1.3175	0.256	
$\sum x^2$	11970.86	5913.02	674.42	135.15	
$\bar{\bar{x}}$	48.91	34.34	11.56	5.19	3081

B. Regional Demand Proportion

1	36.96	38.09	19.13	5.84	617
2	36.86	40.92	16.71	5.51	616
3	37.01	34.91	20.94	7.14	616
4	36.52	36.04	21.59	5.84	616
5	37.66	37.66	20.13	4.55	616
$\bar{x}$	37.002	37.524	19.700	5.776	
s	0.414	2.286	1.908	0.928	
$\sum x^2$	6846.427	7061.16	1955.01	170.253	
$\bar{\bar{x}}$	37.00	37.52	19.71	5.78	3081

C. Seeking Eng. Employment Replication

1	16.53	617
2	14.77	616
3	15.10	616
4	14.29	616
5	14.12	616
$\bar{x}$	14.962	
s	0.9585	
$\sum x^2$	1122.982	
$\bar{\bar{x}}$	14.96	3081

NOTE: $\bar{x}$ Based on overall run of 3,081 items.

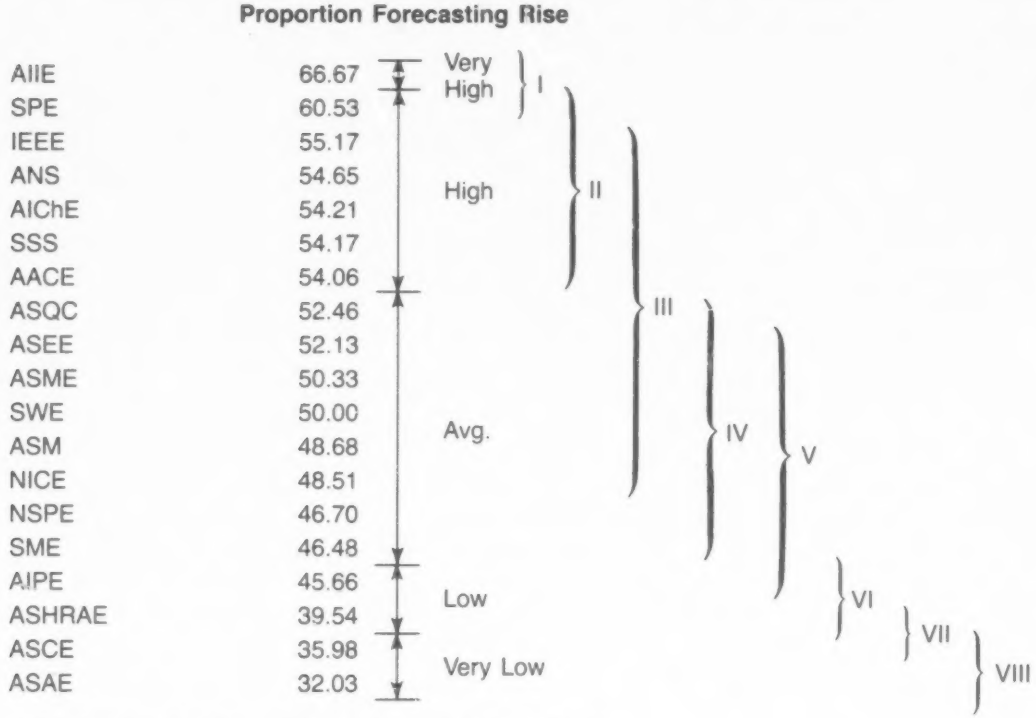
$\bar{x}$ = Mean

$\bar{\bar{x}}$ = Grand mean

s = Standard deviation

TABLE D3-2A

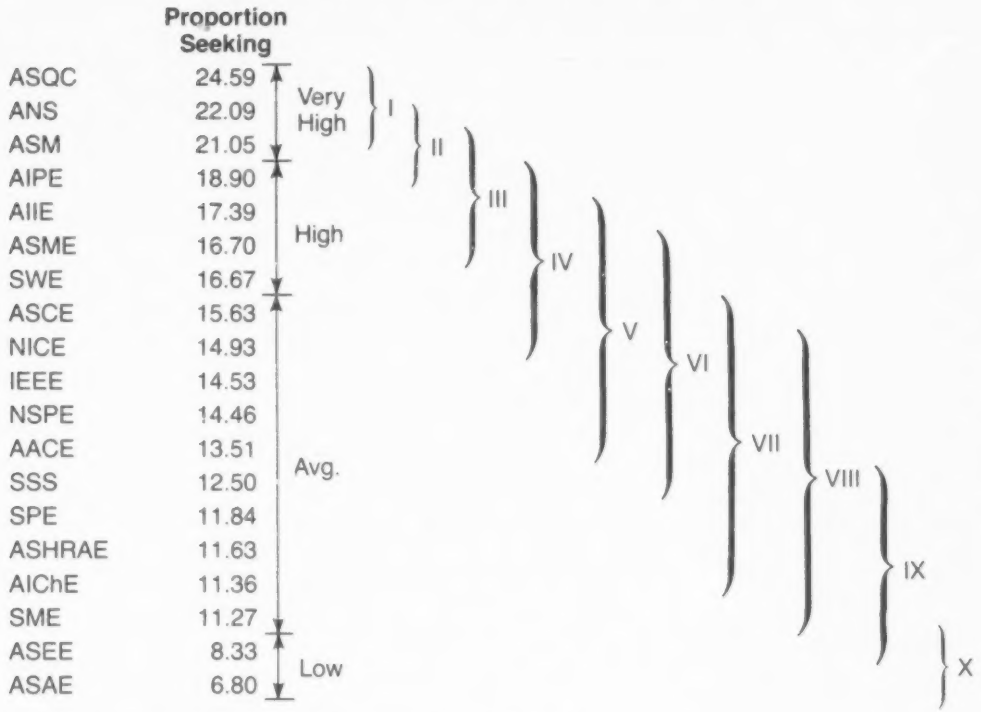
GROUPING OF SOCIETIES BY DEMAND OPTIMISM (USING TUKEY's WSD CRITERION)



NOTE: Brackets indicate alternate groups of societies within which expectation of demand rises is not significantly different.

TABLE D3-2B

GROUPING OF SOCIETIES BY PROPORTION SEEKING ENGINEERING EMPLOYMENT (USING TUKEY's WSD CRITERION)



NOTE: Brackets indicate alternate groups of societies within which expectation of demand rises is not significantly different.

TABLE D3-3

ORGANIZATION SIZE STATISTICS

		Proportions, % Professional Outlook		
Organization Size	**Count**	**Expect Rise**	**Expect Decline**	**Seeking**
Less than 100 Engineers	1773	49.69	11.34	14.95
More than 100 Engineers	1211	49.04	12.30	15.11
TOTAL REPONSE TO SIZE	2984			
$\bar{x}$		49.37	11.82	15.03
s		0.46	0.68	0.11

AAES

MEMBER SOCIETIES

American Society of Civil Engineers	1852
American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.	1871
The American Society of Mechanical Engineers	1880
The Institute of Electrical & Electronics Engineers	1884
American Society for Engineering Education	1893
American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc.	1894
American Society of Agricultural Engineers	1907
American Institute of Chemical Engineers	1908
American Society for Metals	1913
National Council of Engineering Examiners	1920
Society of Manufacturing Engineers	1932
American Institute of Aeronautics and Astronautics	1932
National Society of Professional Engineers	1934
National Institute of Ceramic Engineers	1938
Society of Allied Weight Engineers, Inc.	1939
Society of Plastics Engineers, Inc.	1941
American Society for Quality Control	1946
Standards Engineering Society	1947
American Institute of Industrial Engineers, Inc.	1948
Society of Women Engineers	1950
Society of Fire Protection Engineers	1950
American Institute of Plant Engineers	1954
American Nuclear Society	1954
American Academy of Environmental Engineers	1955
American Association of Cost Engineers	1956
System Safety Society	1962
Association of Energy Engineers	1977
American Indian Science & Engineering Society	1977

ASSOCIATE SOCIETIES

The Tau Beta Pi Association, Inc.	1885
Air Pollution Control Association	1907
American Council of Independent Laboratories, Inc.	1937
American Congress on Surveying & Mapping	1941
National Association of Corrosion Engineers	1945
Federation of Materials Societies	1972
National Action Council for Minorities in Engineering, Inc.	1980

REGIONAL SOCIETIES

Western Society of Engineers	1869
The Cleveland Engineering Society	1880
Engineering Society of Detroit	1895
Washington Society of Engineers	1905
Colorado Society of Engineers	1916
Colorado Engineering Council	1919
Engineering Societies of New England, Inc.	1923
Quad-Cities Engineering and Science Council	1969

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231-82